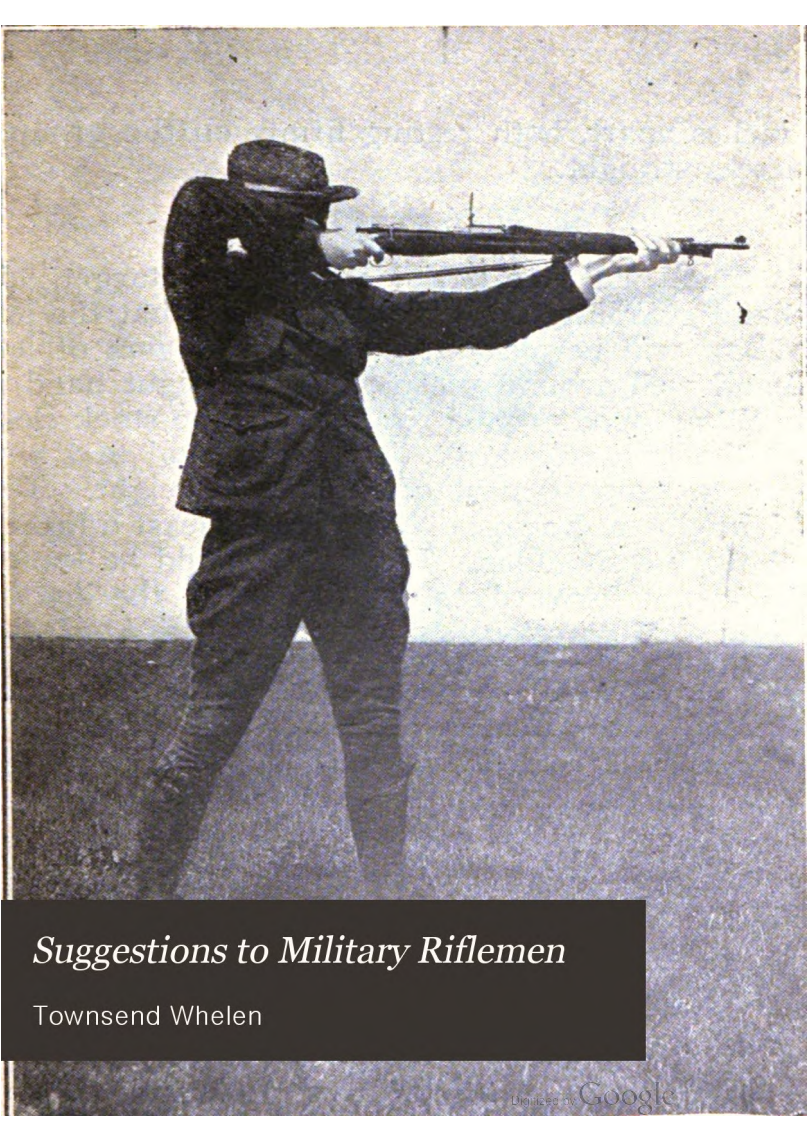

Suggestions to Military Riflemen

Townsend Whelen

FIGURE 1.—U. S. Magazine Rifle, Model 1898 (Krag), Upper.
U. S. Magazine Rifle, Model 1903, with Gun-Sling Adjusted for Firing, Lower.

SECOND EDITION—REVISED.

SUGGESTIONS

TO

Military Riflemen

BY

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LIST OF WORKS CONSULTED.

Arms and the Man, Periodical.
Firing Regulations for Small-Arms, ———.
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Infantry Fire, Batchelor.
Ideal Handbook, Ideal Manufacturing Company.
Journal of the Military Service Institution, Periodical.
Journal of the U. S. Infantry Association, Periodical.
Modern American Rifles, Gould.
Modern Rifle-Shooting, Hudson.
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Small-Arms Firing Regulations, Blunt.
Shooting and Fishing, Periodical.
School of the Krag, Foulke.
The Military Gallery Range, Bell.
The Book of the Rifle, Fremantle.

INTRODUCTION.

In the days of the old Springfield rifle Blunt's Firing Regulations contained an excellent chapter entitled "Suggestions to Riflemen." This work, a most excellent one, was widely consulted and assisted to a large extent in improving the marksmanship in the Army. To-day, however, rifle-firing has reached such a science that it is impossible to burden our Firing Regulations with this subject. The need of such information and knowledge in the Service is greater than ever, and the desire for it expressed to me by many officers of the regular Army and National Guard has induced me to undertake this work. While the great part of it is compiled from my own experience, I have consulted practically all the modern writings on the subject obtainable in my endeavors to present to the reader everything on the subject of any practical value.

I shall not attempt to describe the rifle, for I do not care to take up the space necessary. The best description of it will be found in a pamphlet

entitled "Description and Rules for the Management of the U. S. Magazine Rifle, Model 1903." Nor will any of the data which is contained in the Firing Regulations for Small-Arms, other that that which is absolutely necessary to make the text clear, appear in these pages. A knowledge of the contents of both these works is necessary to a clear understanding of what is to follow. The reader is referred to any of the standard works on ballistics for the scientific part of rifle-shooting, as I shall take up only the practical side of the subject, it being my intention to give fully that information which the marksman and the instructor need to shoot and to teach on the range and battle-field.

The text of this work refers only to the U. S. Magazine Rifle, Cal. 30, Model 1903, chambered for the Model 1906 ammunition, popularly known as the "New Springfield." The U. S. Magazine Rifle, Cal. 30, Model 1898 (Krag-Jorgensen), which is still in use in the Military Schools and in the hands of many civilian riflemen, has been thoroughly covered in the part of the Appendix relating to it. The general remarks throughout the book will pertain equally to both rifles.

Rifle-shooting, as a science, is advancing with such rapidity that it would seem that no sooner

is a work published on the subject than it becomes obsolete. This is particularly true of the last five years, during which time great advances have been made, both in arms and ammunition and in the skill of our riflemen, thus adding greatly to the strength of the Nation. I should like here to give credit for this to the National Rifle Association, for their energetic work of promoting and encouraging rifle-shooting in the National Guard and among the citizens throughout the United States; to every officer in our regular Service, for their great interest and painstaking work in developing marksmanship in the Army; and to the Ordnance Department of the Army, for so ably perfecting and giving to us an arm which this year has clearly proved itself to be the best in the world.

As our skill with the rifle progresses our Small-Arms Firing Regulations must of necessity change also to keep pace. Several years ago the 1000-yard range was considered an extremely difficult one. To-day it is so easy that we can with profit move back to longer ranges. As this edition goes to press a board of officers is at work on a revision of the Small-Arms Firing Regulations, but it is not thought necessary to await the publication of their work. The purpose of this book is not so much to teach men

to qualify in the higher grades of marksmanship and to win competitions, as it is to teach those principles of good shooting which will enable men to make the largest proportion of hits under battle conditions. There is a tendency now to make shooting conditions more practical; to restrict shooting at bull's-eye targets to the beginner and to the finished marksman learning the shooting peculiarities of a new rifle or a new ammunition. Advance practice will consist in firing at targets which in their appearance, the time they are in sight, and their movements will approximate as nearly as possible an enemy on the battlefield. And this is decidedly a move in the right direction. For such shooting no absolute rule can be laid down. The principles of good shooting, well grounded, and a thorough knowledge of the rifle are what is needed.

In order to make the book of practical working value, I have given the addresses where various preparations and devices can be obtained.

In the preparation of this work I am greatly indebted to many officers of the regular Service for valuable suggestions, and particularly to Dr. Walter G. Hudson, not only for the knowledge gained from his many writings on the subject,

but also for kind suggestions regarding the revision of the book.

It is my hope that I have given to the Service something which officers and individuals will care to study and to carry to the range with them.

TOWNSEND WHELEN.

Fort William McKinley,
Philippine Islands, 1909.

CHAPTER I.

The Selection of an Accurate Rifle.

The manufacture of our army rifle has reached such a degree of perfection that one would be almost safe in saying that all new rifles are accurate. Some will be found a little more so than others; some will be found which will retain their accuracy for a greater number of rounds than usual, and once in a great while one will be found which will not do justice to the holding of an expert shot and which will become inaccurate quickly. In order to do good shooting, it is necessary that one should have confidence in his rifle; and in order that we may cast aside the inaccurate and quick-wearing rifles for expert work, and also that we may have a knowledge of what constitutes a good-shooting, long-lived arm, the knowledge of how to select an accurate rifle is necessary.

The only infallible way of choosing an accurate rifle is to have it shot from a machine rest (vise), at 1000 yards, on a perfect day, by

an expert. But a rifle selected in this way only, with no reference to size of bore, is risky, as, if the bore is large, its fine shooting qualities will very quickly vanish. There are certain characteristics or "ear-marks" which all good rifles have, and with a knowledge of these and a certain amount of skill in determining them a rifle may be selected with almost a certainty that it will perform well at the target at long range.

In selecting a rifle the points to be observed are: *the muzzle, the bore,* and *the stock.*

The muzzle should be bright, free from rust and any injury or burr. The lands and grooves should be cleanly and sharply cut right up to their end. Examine the muzzle under a magnifying-glass. The dulling or rounding of the square edges of the lands and grooves by the cleaning-rod or thong should be especially looked for, as this is the principal defect in the muzzles of rifles which have been in the hands of troops for any length of time. Any of these defects, and particularly the latter, should be a cause for instant rejection. It must be remembered that the muzzle of the rifle is its most delicate and important part, for any injury or wear to it will allow the powder gas to escape on one side of the base of the bullet before the other at the instant that the base of the bullet

leaves the barrel. Thus the gas first escaping will cause the bullet to tip from its correct line of departure and make the flight unsteady. Everything depends on perfect delivery of the bullet point on.

The rifle is first smooth-bored .300 inch in diameter and is then rifled .004 inch deep, making the measurements of the bore from the bottom of one groove to the bottom of the opposite groove .308 inch. Owing, however, to the speed of manufacture, lack of homogeneity in the barrel steel, and the wear of the tools, barrels will vary in their diameter from .307 inch to .310 inch, and some of them will be large (loose) in one place and small (tight) in another place throughout their length. To be accurate and have long-wearing qualities, the barrel should measure from the bottom of one groove to the bottom of the opposite groove not more than .3085 inch nor less than .30775 inch, and there should be no large or small places—*i. e.*, it should be a perfect cylinder or else it should be a trifle smaller at the muzzle than breech, with a smooth, even taper the entire distance. The ideal barrel would measure .30825 at the breech and .308 at the muzzle.

The measuring of the interior of a rifle barrel is not so difficult as it appears, and anyone can

become fairly expert at it in twenty or thirty trials. The implements necessary are a Brown & Sharpe's micrometer calipers, measuring to thousandths of an inch an object 1 inch or smaller, which can be obtained from any first-class hardware store; a cleaning-rod 36 inches long (40 inches for the Krag) and a quantity of soft lead conical bullets measuring .313 inch.* The cleaning-rod should be made of ¼-inch steel or brass by any gunsmith.

The barrel of the rifle is first made absolutely clean and then oiled slightly with a thin gun oil similar to "3 in 1." Now place the rifle with the muzzle resting on a wood floor, barrel vertical, bolt removed, and drop a bullet, point first, into the chamber so it will rest against the rifling at the throat of the chamber. With the end of the cleaning-rod hammer it about an inch into the rifling. This expands the bullet to fill the grooves of the rifling perfectly. Grasp the cleaning-rod by the end and with a steady, powerful motion push the bullet through the barrel until it rests in the muzzle against the floor. Do not allow the bullet to stop in its passage. It

*The best bullets are those for the .32-20 Winchester Center Fire Cartridge, which can be obtained in lots of 1,000 from the Winchester Repeating Arms Co., New Haven, Conn., or throhgh any sporting goods dealer.

will take considerable force to start it. As it is passing through try to determine by the resistance offered to the pressure the presence of any tight, loose, or rough places and their location. This will come quickly with practice.

Now reverse the rifle and with the cleaning-rod still in the barrel, the right hand holding the cleaning-rod and the left hand holding the muzzle, tap the base of the bullet gently with the rod until the point protrudes from the muzzle and only about an eighth of an inch of the bullet remains in the rifling. Grasp the point of the bullet very lightly with the fingers and try by very light side pressure to move it. If it remains immovable, it is a sign of a good tight muzzle, which is very desirable. Very gently tap the bullet out of the barrel, being careful to catch it in the fingers and prevent any injury. Wipe the surplus oil off carefully and measure its largest diameter near the base with the micrometer calipers. The points at which the calipers should touch the bullet are the projections on the bullet which have been riding on the center of the grooves of the barrel. In using the calipers be sure that the contact points are perfectly clean and use no force in screwing up for measurement. This measurement will give you the smallest diameter in the barrel, meas-

uring from the bottom of one groove to the bottom of the opposite. If this is over .3085 inch or under .30775 inch, or if there are loose places near the muzzle, tight places near the breech, or very rough places anywhere, discard the gun for expert use. Note that it is often very hard to start the bullet traveling through the barrel, and do not confuse this with a tight place near the breech.

Supposing the gun has passed this test, we should next measure the breech and muzzle. To measure the breech, insert a bullet 1 inch into the rifling as before and then enter the cleaning-rod in the muzzle and drive it out gently, being sure to catch it in the fingers as it leaves the chamber to prevent injury; then measure. To measure the muzzle, force the bullet clear through the barrel to the muzzle as in the first instance, then rest the muzzle on the wood floor and with the cleaning-rod pound the base of the bullet until you are sure it is expanded to the muzzle size; then drive out carefully and measure.

It is not to be understood that rifles which do not pass this test are not accurate enough for target work. It is very rare indeed that a poor-shooting rifle gets past the inspectors. For the use of experts and competitors, however, the rifle should pass these tests, as the rifle doing

so will be the most accurate and have the longest life. Generally speaking, a rifle barrel measuring over .309 inch will not satisfy a good shot in the size of its shot groups and in its wearing qualities, and one as large as .310 is apt to shoot rather poorly; but, as I have said, these are few and far between. The reasons for discarding rifles of these diameters will be treated fully in the chapter on "Ammunition." This method of choosing a rifle is not infallible, for a rifle may pass all these tests and yet not be bored straight; but I have never yet found such a one.

Instead of forcing the bullet though the barrel by the pressure of the hand in gauging, some riflemen prefer to drive it through by blows on the end of the cleaning-rod, delivered with a hammer. The blow is struck so as to drive the bullet through about half an inch of barrel at each blow, and any tight, loose, or rough places in the bore are quickly noticed by the varying resistance to the blow of the hammer and the distance which the bullet travels each blow. Care should be taken that the blows of the hammer are as nearly as possible of the same energy.

Having found a good barrel, be sure that the stock is of the best. The stock should be well seasoned and the grain of the fore part under the barrel should run parallel with the barrel;

otherwise, if the stock warps from moisture, it will pull and press unevenly on the barrel and change the shooting of the piece. As the barrel heats up from firing it will increase in length, the average increase during a skirmish run being .02 inch; and if the bands which bind the stock to the barrel are very tight and retard this expansion, the barrel will actually buckle or bend; thus as the gun heats up the bullets will either fly higher or lower, generally the latter. Allowance has been made in the fitting of the bands to allow the barrel to expand freely, but often a stock and hand-guard will swell from moisture, particularly in a damp climate like the Philippine Islands. If such has occurred, the stock and hand-guard should be removed and the surfaces where they come in contact with the barrel and upper band should be slightly smoothed down with sand-paper so that the barrel will be free to expand, and the upper band will go back to its place by the pressure of the hand alone. This should be done only when necessary and should not be carried too far, as the stock and hand-guard should give firm and even support to the barrel to enable it to do the most regular work. It is not believed that this treatment is regarded as a violation of Paragraph 287, Army Regulations, which prohibits

the mutilation of any part of a rifle by filing or otherwise. Enlisted men desiring to take their rifles apart should obtain the permission of a commissioned officer.

If the trigger pull does not suit you, do not attempt to alter it by grinding down the sear nose and sear notch, as I have seen many do. This is very dangerous, often causing premature discharges; and besides, it is a distinct violation of the above-mentioned paragraph, and renders one's rifle liable to be disqualified at any time. Instead try placing other firing-pins in your bolt, and you will quickly find one which will give a good, clean pull without drag or grate. With the majority of rifles the pull is satisfactory as issued. The minimum pull allowed by regulations is three pounds, and is tested by applying the weight to the middle of the trigger so that the pull will come in a line parallel to the barrel of the rifle. It is not really desirable to have the pull approach the minimum in weight. A clean pull of five pounds feels lighter to the finger than one of three pounds containing a drag.

CHAPTER II.

The Care of the Rifle.

A rifle requires a large amount of care to keep it in perfect condition. More rifles in the hands of troops are injured by cleaning and by the lack of proper cleaning than in any other way. In the days of black powder all that was necessary was to wipe out the powder dirt with water and rags, dry the bore, and apply oil; but such treatment, or, rather, lack of treatment, would ruin one of our present rifles in about three days. The proper cleaning of a modern rifle is a complicated chemical process, and this must be realized if one wishes the good shooting qualities of his piece to last for more than a few days. I have seen many rifles which after a week's use on the range were absolutely useless for good shooting, being pitted, rusted, and filled with an accumulation of cupro-nickel; and I have also seen thousands of rifles which were bright, clean and free from rust, but which were absolutely useless for accurate work

from having been cleaned from the muzzle. If a rifle is cleaned from the muzzle, it takes only a few days for the cleaning-rod to dull the muzzle, and then the gun begins to scatter. The reason for this has been given in the previous chapter. A "pull through" or thong, if used right (that is, inserted in the muzzle and pulled through to the breech), does not injure the muzzle; but it is a very hard and tedious process to clean a rifle thoroughly with a thong. Moreover, the thong is liable to break, and of all obstructions in the barrel a broken thong is the hardest to get out. The only safe way of cleaning is from the breech with a long cleaning-rod. This rod should be 36 inches long and made of ¼-inch tool steel or brass, with a tip like the cut. The expert shot prefers a steel rod, because experience proves that dirt will stick to the softer metal and cut into the harder. For a company, however, brass is best, for with inexperienced men the time will come when one of them will get a rag and rod stuck in the barrel, and in a case like this the steel rod may injure the barrel while being removed. For cleaning use preferably Canton flannel patches about an inch square, the exact size to be determined by experiment. The rags should not fit the barrel very tightly, and no great force should be

necessary to push them through or pull them back. This is important. Also be sure not to use damp rags or rags of poor or thin cloth that the point of the rod may puncture. A rag stuck in the barrel is a very dangerous thing for the piece.

To clean a rifle, remove the bolt, place the muzzle on the floor, barrel vertical, and never remove the muzzle from the floor. Place a patch in the bolt well and with the little finger center it down over the chamber, then center it with the point of the rod, push it down to the floor, and pull it back, working it up or down four or five times. This will clean all the bore except about an eighth of an inch of the muzzle end. To clean this, use a patch on a pointed pine stick, and with the same stick clean the chamber.

The fouling caused by the service cartridge may be divided under three heads.

First, a black carbon fouling. This is easily seen, and one or two rags will wipe it out, when the barrel appears clean; but look out, for it is not, and if the cleaning progresses no farther than this, the barrel will be so pitted and rusted in a day or two as to be ruined.

Second, a sticky and almost transparent fouling. This is very acid in its action, through the incorporation in it of the products of the primer

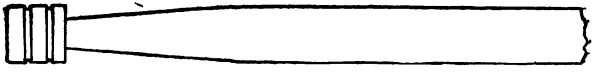


FIGURE 2.
Tip of the Cleaning-Rod.

combustion, and will soon set up rust if not removed. It is almost proof against water or oil, sticks very tenaciously to the bore, and is actually driven into the pores of the metal, sweating out to the surface gradually for several days after firing. This explains why rifles, cleaned in the ordinary way after firing, are found several days afterward dirty and rusty inside. To remove it, some alkaline cleaning solution is necessary. I mention a number of efficient ones in order that you may choose the one most convenient or the one easiest obtainable in an out-of-the-way place.

In the field boiling water poured through the barrel will do in a pinch. Remove the bolt and magazine floor plate, spring and follower, and look out for the stock, hand-guard, and sights; then dry thoroughly. This is not very efficient, however. A saturated solution of sal-soda and water is good. This is very alkaline and must be removed and the bore dried immediately after use. Sal-soda is provided by the Ordnance Department for the purpose, and may be procured therefrom by a company on approved requisition. Aqua ammonia containing 28 per cent gas is excellent, but it also must be removed from the bore immediately after use. The best preparation found so far, however, is a liquid termed

Powder Solvent No. 9, prepared and sold by Frank A. Hoppe, 1741 North Darien Street, Philadelphia. Many riflemen also use a solution devised by Dr. W. G. Hudson, composed as follows:

Kerosene oil, free from acid, 2 ounces;
Sperm oil, 1 ounce;
Turpentine, 1 ounce;
Acetone, 1 ounce.

These last two preparations may be left in the bore (being fairly good rust-preventatives) for a day or two after applying. When shooting the rifle daily, I prefer after cleaning to pass a rag wet with Powder Solvent No. 9 through the bore. It seems to neutralize any acid fouling which may sweat out of the pores of the metal over night, and is easily removed from the bore the next morning with a few patches, making the use of gasoline or chloroform unnecessary. When a gun has not been cleaned for forty-eight hours and a clean patch pushed through comes out clean, then the gun may be oiled with cosmic oil and put away with safety.

Third, metal fouling, sometimes called cupro-nickel fouling or nickeling. This consists of particles of the cupro-nickel jacket of the bullet, and is welded to the bore by the heat and pressure. In the muzzle half of the barrel it appears

in the form of small lumps or flakes clearly discernible to the eye. In the breech half it is more like a thin plating or wash. It occurs more in roughly bored barrels than in smooth ones, sticking tightly to the rough places; also more in barrels that have been fired considerably than in new ones. It is really an obstruction to the bore, and accumulates more and more with every shot, so that after about fifty shots the rifle may change its elevation and zero considerably, and in aggravated cases it will greatly enlarge the shot group. When deposited, it imprisons the acid fouling under it, and as in this case the ordinary cleaning solutions cannot get at the latter fouling, it follows that a barrel not cleaned regularly from metal fouling will become pitted under that fouling. This metal fouling should be removed about every fifty rounds with the nickel fouling solution, in order to get the best work from the barrel. For the proper preservation of the rifle, it should certainly be removed every evening after firing has ceased.

We now come to

THE PROPER METHOD OF CLEANING.

As soon as possible after firing, clean the bore with any of the solutions mentioned under "acid fouling" and dry with clean patches. If the barrel is still hot, put it one side until it cools be-

fore proceeding further. Then place a rubber cork in the chamber and a rubber tube several inches long over the muzzle. Then stand the rifle upright and fill the bore, covering the muzzle, with the metal fouling solution, the formula for which is as follows:

Ammonia persulphate, 1 ounce;
Ammonia carbonate, 200 grains;
Aqua ammonia (containing 28 per cent ammonia gas), 6 ounces;
Water, 4 ounces.

This prescription is sufficient for about seven barrels. The solution should be allowed to stand in the barrel for half an hour, not longer. Before using it is colorless; but when poured out of the barrel, if cupro-nickel be present, it will be a deep blue color, and all metal fouling, acid fouling, etc., will be removed. The solution is very corrosive to steel if allowed to evaporate on it, but does not injure it while completely wet; therefore as soon as the solution is poured out, the barrel should be cleaned of all ammonia with dry patches, and then, to make sure, a patch wet with oil should be run through the bore, which will saponify any trace of ammonia remaining. Then the oil should be wiped out and the bore should have a five-minute polishing with chamois-skin patches coated with Acheson

Graphite, Grade No. 1340, procurable from the International Acheson Graphite Company of Niagara Falls, N. Y., at 60 cents a pound, post paid. Then oil the bore, and the barrel is perfectly cleaned and needs no further attention.

The application of this method of cleaning will be made less difficult by attention to the following details: The various ammonia preparations should be kept in tightly corked bottles to prevent evaporation and loss of strength, and these bottles should have rubber or glass stoppers, as ammonia quickly burns up cork. The solution should not be mixed until wanted for immediate use, as it very soon loses its strength through the gas it throws off; and, morever, this gas is of such volume that it will blow the cork out of any bottle, or burst the bottle. The best method of mixing the solution for the cleaning of a single rifle is as follows: Procure a small glass vial of about three ounces capacity, cork up the chamber of the rifle, fill the barrel full of water, and then pour this water into the vial and make a mark where the water comes to. This will give a measure for the correct amount of solution needed to fill the barrel. Pour out two-fifths of the water from the vial and again make a mark on the glass at the new water level. Now make two little measures of old cartridge

shells which will measure approximately one-sixth of an ounce of ammonia persulphate and 33 grains of ammonia carbonate. These last two are crystal, and this amount of each should be pulverized together and placed in the vial. Now fill the vial to the lower mark with aqua ammonia and to the upper mark with water. Stir slightly until the persulphate and carbonate are dissolved, and then fill the barrel. You had best mix the solution out of doors, as the fumes are very strong.

In some localities ammonia persulphate is very difficult to procure. Order it in good time before the shooting season; or, if you cannot get it, use the following prescription:

Aqua ammonia, 1 ounce;
Ammonia carbonate, 25 grains;
Caustic potash, 1 grain.

The graphite is used to restore the polish to the bore of the rifle and is a very important factor in retarding the rapid accumulation of cupro-nickel. The final application of oil is merely a rust-preventative. Good rust-preventatives are Cosmic No. 80, Soft, which is issued for this purpose upon requisition by the Ordnance Department, and Gas Engine Cylinder Oil. These are very thick oils, and to remove them quickly from the bore before firing again, it is

necessary to use gasoline or chloroform. Where the rifle is being used daily, sperm oil is good, as it can be wiped out quickly with flannel patches alone. These oils are very cheap (enough for a season's use can be purchased for a few cents), and they are every bit as efficient as "3 in 1" and the patent gun greases, which are very much more expensive.

It is, of course, obvious that this method of cleaning cannot be used in active campaign. The best method of cleaning under these circumstances is as follows: Carry in the haversack a small tin box containing sal-soda, a waterproof bag containing flannel patches, and a small metal flask containing Marble's Nitro Solvent Oil, or, if unable to procure it, sperm oil. I would also advise you to place no reliance on the thong and brush, which are intended for emergency only, but to obtain a Marble Pocket Rifle Rod, which has joints 9 inches long and comes in a neat leather case and weighs only 8 ounces, and a Marble Rifle Cleaner, composed of soft brass gauze washers, which fits on the rod. Clean first with patches wet with a saturated solution of sal-soda and water; then dry and clean again with the rifle cleaner dipped in oil; then clean again with dry patches until a patch comes out clean, and then oil. Repeat

this cleaning the following day. This is a makeshift, but the sal-soda neutralizes the acid fouling and the cleaner cuts out the worst of the metal fouling. Nitro solvent oil, the cleaning-rod, and the cleaner can be had from the Marble Safety Axe Co., Gladstone, Michigan, and also at most sporting goods stores.

Except in an emergency in the tropics, no vegetable oil should ever be used in a rifle.

The action, bolt, etc., should be liberally oiled with sperm oil. Raw linseed oil should be rubbed into the stock by hand weekly and after any wetting by rain. The rifle should never be laid on the damp ground, as this will often cause the stock to warp, and often change the "zero" of the rifle.

A piece of chamois-skin thoroughly saturated with oil is a good thing to carry to wipe the rifle off with after a day's shooting, to prevent the moisture of the hands from rusting the rifle. Once thoroughly saturated, it will last a lifetime and is a great saver of oil.

Never leave a rag in the muzzle of the gun. If the air is damp, it will collect moisture and rust the muzzle. Besides, you are liable to fire the rifle some day without removing the rag, when the best you can hope for is a ruined rifle.

A company should be provided with a long cleaning-rod for each squad, and the men should

be able to procure the various cleaning materials in the post exchange. The men should be thoroughly instructed how to clean their rifles, and a company order should then be issued prohibiting cleaning in any other way; this order being aimed particularly at cleaning from the muzzle. The muzzle cannot be guarded too carefully.

Before going on the range, carefully wipe all oil or cleaning solution from the bore. The bore must be perfectly clean and dry before firing. The presence of any oil in the barrel will cause the first few shots to go high and exceedingly wild. For the same reason cartridges should never be lubricated nor wet with saliva.

It is the practice of the best shots, after wiping the bore clean, and before firing, to coat the bullets with Acheson graphite applied with a chamois-skin. This graphite is made in an electric furnace at a very high temperature and it will easily stand the highest temperature found in the barrel. It thus offers a perfect lubricant to the bore and bullet. It is claimed that its use in this manner reduces friction, prolongs the life of the barrel, increases the velocity slightly, and prevents the metal fouling being deposited in the large lumps which do so much towards destroying accuracy. The rifle will shoot a trifle higher when graphite is used, but this seems to be very constant.

CHAPTER III.

The Firing Positions.

1. *The Standing Position.*

The standing position will be used almost entirely in short-range firing, or at longer ranges when the objective cannot be seen in the sitting or kneeling positions. Unlike the other positions, no specific rule can be laid as to how the rifle should be held. The conformation and muscular development of men differ so much that it is far better to allow them, with certain restrictions, to select their own position, than to compel them to take any prescribed one.

The standing or "off-hand" position may be subdivided into four distinct positions:

The full-arm extension,
The half-arm extension,
The body-rest,
The hip-rest.

We will take these up separately, describing each and showing to what class of men they are best suited.

The following general rules will apply to all positions:

The body must never be inclined forward, but an even balance on both feet must be assumed. When the rifle is raised, the body should be inclined very slightly backward to regain the perfect balance which the extended rifle has temporarily destroyed. A perfect balance throughout the whole body is very important, as, if any part is out of balance, that part is under strain, and hence will tremble.

The right elbow must be held high enough to insure that the entire butt-plate from toe to heel rests against the shoulder.

The head must not be inclined over the stock, but the right cheek should rest against the side of the stock.

The right hand should do more than half the work of holding the rifle against the shoulder.

In the first three positions the fingers of the left hand should nearly encircle the barrel, holding down firmly against the jump of recoil.

The rifle must be held exactly the same, as regards grip of the hands and pressure against the shoulder, for each shot. It is actually possible to make the shots vary as much as 4 inches at 200 yards by varying the pressure.

The feet in all positions should be about 12

FIGURE 3.—Standing Position, Full-Arm Extension.

inches apart, both resting firmly on the ground, knees straight.

The Half-Arm Extension.

Stand with the left side facing the target, left hand grasping the barrel so far out that the left elbow will be absolutely straight, fingers of left hand well around the piece. The right hand is well wrapped around the small of the stock close to the trigger-guard. The right hand and arm are to support most of the rifle's weight. The right elbow should be very high, at least 6 inches above the shoulder. The head should be leaned back, not forward, to get the eye in the line of sight. All motions to change position of the sights on the target are made by swinging on the hips. The left hand steadies and controls the piece with very little effort.

This is pre-eminently the position for shooting in a strong wind. It can be assumed best by tall men and those having strong deltoid (shoulder) and trapezius (upper back) muscles. It is not adapted to men who stoop, small men, or those deficient in muscular development.

The Full-Arm Extension.

This is the best all-around standing position. It is the best position for rapid fire, for snap-

FIGURE 4.—Standing Position, Half-Arm Extension.

shooting, and for use when the marksman is unsteady from recent muscular exertion.

Take the same position as in the full-arm extension, except that the left elbow is slightly bent, left hand grasps the piece just below the lower band, and the left elbow is well under the piece. This last is important. Only the weight of the arm is allowed to pull against the grip of the left hand. The right hand does all the rest of the work of holding the rifle to the shoulder. When the bolt is worked in rapid fire, the left hands pulls the rifle hard against the shoulder and holds it in firing position while the right manipulates the bolt. Figure 4 shows the position with the sling, which may or may not be used.

This position may be used advantageously by all men, and should be the first one taught and the one most encouraged. While it is the best for all-around shooting and the one which will give the best average results, it is the hardest one in which to hold the rifle still.

The Body-Rest Position.

The left hand is placed against and in front of the trigger-guard, which rests in the hollow of the hand, while the fingers are wrapped well around the receiver and bolt handle, left fore-

FIGURE 5.—Standing Position, Body-Rest.

arm is vertical, and left upper arm is resting against and clinging to the breast. Rifle held to the shoulder and supported equally by both hands, right elbow level with the butt, head advanced into line of sight. All motions to change the position of the sights on the target are made by swinging on the hips as a pivot.

This position is a very steady one. It is not adapted to rapid fire, as in order to work the bolt it is necessary to change the position of the left hand and take the piece from the shoulder. Nor is it adapted to snap-shooting, for it is a hard position to assume quickly. It is not a good position for use in the wind.

It is best assumed by men who tend toward stoutness, and those who lack muscular development will probably choose it. Thin men will find difficulty in resting the left arm against the breast.

The Hip-Rest Position.

The left elbow rests aginst the point of the left hip (pelvis bone). The rifle is balanced on the tips of the thumb and first and second fingers of the left hand. The thumb rests against the bottom of the trigger-guard and the fingers against the stock about 5 inches in front of the trigger-guard, left wrist held very stiff. Right

FIGURE 6.—Standing Position, Hip-Rest.

hand and arm same as in the body-rest position. The right hand must do all the work of holding the rifle against the shoulder. The left arm and fingers support the piece. It makes the bones of the body form a structure from the ground up to support the rifle and takes the work almost entirely from the muscles.

There comes a time in the shooting of every man who practices this position when he can hold absolutely still for several seconds so as not to be able to see any motion of the sights on the target. The trouble then comes in pulling the trigger, for the whole body is "frozen." This position is the steadiest of all when there is no wind and the marksman is not unsteady from previous muscular exertion. It is impossible to use it in the wind. It almost entirely eliminates vertical errors. It can be assumed best by men who are thin and those with small waists, or men who stoop. Some men cannot rest the elbow on the hip. All men who can assume it should be taught to use it, as for them it is the best position for deliberate slow fire on still days. It is obviously unsuitable for rapid or snap-shooting.

It is my opinion that the best work in the standing position can only be obtained when two or more positions are known thoroughly. For

FIGURE 7.—Kneeling Position.

instance, the full-arm extension for use on windy days, the half-arm extension in rapid fire, snap-shooting, and under excitement, and the hip-rest for slow fire on calm days.

2. *The Kneeling Position.*

Assume the position as in the Drill Regulations, adjusting the sling as shown in Figure 7, and have it very tight. The left hand grasps the piece just under the rear sight. The sole of the shoe should be very heavy, and one should be able to sit on the right heel so comfortably as to be absolutely steady. Few men can do this, and for those who cannot the sitting position is far better.

The kneeling position is steadier than the standing. It is quickly assumed and one can take up the advance quickly from it. The sling holds the piece steadily in the firing position while the bolt is worked in rapid fire. It can be assumed only on smooth ground. It is hard to use in firing either up or down hill, and is a miserable position for those who cannot sit comfortably on the right heel.

3. *The Sitting Position.*

Assume the position illustrated in the Firing Regulation or cross the legs as in Figure 8. In order to be able to hold steadily in the first posi-

FIGURE 8.—Sitting Position, Legs Crossed.

tion, it is absolutely essential to have large holes in the ground to support almost the entire sole of the foot in its natural position. The second position is very steady and can be assumed when there is no time for making holes in the ground. It is a little awkward to assume, especially for stout men. Use the sling as illustrated, having it very tight. Elbows should be in the hollow of the inside of the knees. When working the bolt in rapid fire, hold the piece hard in the firing position with the left hand and sling and work the bolt with the right hand, the right knee assisting the right arm and the right elbow and knee never losing contact. The left hand must grasp well around the piece with the stock resting hard against the bones at the base of the palm. Don't get the rifle up on the fingers of the left hand, or it will tremble.

This position, even when one is obliged to assume it hurriedly, is a very steady one, and when time is available for digging holes for the feet, the rifle can be held almost as steadily as in the prone position. It is the only position which can be assumed when the marksman is on a steep hillside and firing downward. It is a very efficient position for rapid fire, particularly where more than one magazineful is to be fired.

FIGURE 9.—Prone Position, Showing the Use of the Gun-sling.

4. *The Prone Position.*

Lie flat on the ground—the closer you can get to the ground the better. Lie at an angle of 45 degrees with the target, not head on (see figure). Spread the legs wide apart to allow the stomach to lie flat on the ground, thus taking away all trembling from this part of the body. Grasp the rifle at the balance or farther forward with the left hand, left elbow well under the piece, right hand at the small of the stock. Assume the firing position; then lower the rifle, and noting where the elbows have rested, with an old hatchet dig holes for them. This is unnecessary on grass or soft ground. The elbows must not only not slip, but there must be no feeling when they are in position that they might possibly slip, for if this feeling is present, the position will be unsteady. The cheek should rest comfortably against the stock. This position without using the sling is as steady as the sitting position. When the sling is used properly as described below, it becomes as steady as a rock. This position can be assumed on any ground except that which has considerable slope to the front or flanks. It is the best position for long-range work, extreme accuracy, and rapid fire. It can be assumed more quickly than any other position except the standing.

The Use of the Gun-Sling.

The gun-sling should be used whenever it is possible to do so. It is even more of a factor in fine marksmanship than the wind-gauge. By its use the rifle may held absolutely steady; in rapid fire it facilitates the quick return of the rifle to the point of aim, and it takes up almost half of the recoil. I am opposed to any way of using the sling other than as shown in the preceding cuts. The experience of hundreds of expert shots* has proven this to be the best and only practical way of using it.

The sling is made up of four parts: the long strap, the short strap, and two keepers. To assemble it, the plain end of the long strap is passed through the larger keeper, then through the metal loop of the short strap, passing from the undressed to the dressed side of the latter, then back through the larger keeper, forming the arm-loop dressed side out. The same end is then passed through the smaller keeper, through the upper sling swivel from the butt toward the muzzle, and back through the smaller keeper,

*When the word "expert" is used in this work, it is not to be understood to mean simply a man who has qualified as "expert rifleman," but rather one who is in every respect a finished shot and who is well up in all the theory and practice of rifle-shooting.

the arm-loop being completed by engaging the claw of the long strap in the proper holes in the other end of same.

The size of the arm-loop is adjusted to suit the individual who is to fire the piece, the loop being drawn through the upper swivel until the claw comes well up toward the upper swivel. The claw end of the short strap is then passed through the lower swivel from muzzle to butt and brought up and engaged in the proper holes in the long strap, drawing the sling taut. This gives the *parade* position of the sling.

To adjust it for *firing* or *carrying,* the claw of the short strap is disengaged and re-engaged in the proper holes of the short strap, no change being necessary in the adjustment of the arm-loop.*

The essential points in the use of the sling are as follows:

The tension must come from the lower band (from attachment) of the sling only.

The arm-loop must pass to the right of the left wrist to prevent canting, and thence around the left upper arm, preferably above the swelling of the triceps muscle.

The short strap must be loose in all positions, as any tension here will cause the rifle to be

*Circular No. 16, War Department, March 7, 1907.

canted to the right and will pull the butt away from the shoulder.

The arm-loop must be made short enough to enable the rifleman to place a heavy pressure (about 75 pounds) on the sling—equal, of course, for each shot. This is what is meant by "holding hard," and it will cause the piece to steady down like a rock and distribute the recoil to the entire body so that the shoulder will scarcely feel anything.

The left hand should always grasp the rifle well around the stock, letting the stock down on the bones of the palm of the hand near the wrist; for if this part of the hand be held away from the stock, the rifle will rest on the fingers and each separate finger will tremble slightly. The theory of the position is that the arm-loop binds the bones of the forearm to the rifle and to the ground or knee, and the heavy tension makes it a dead rest with a universal joint, the wrist, at its upper extremity.

These remarks pertain more particularly to the kneeling, sitting, and prone positions. It is doubtful if the sling is of much use in slow fire in the standing position, except when shooting in a high wind, which makes the holding unsteady. In rapid fire standing, however, its use as shown in Figure 4 takes up so much of the recoil that

the rifle does not move off the target when firing or while working the bolt.

In rapid fire prone and in skirmish, as the bolt is pulled back by the right hand, right elbow remaining on the ground, the left hand should move to the right and low, without changing its grip on the rifle, causing a corresponding movement to the muzzle of the piece. As the bolt is closed the left hand brings the rifle back to its aim on the target, and a little practice enables one to bring the piece back exactly so that the aim for succeeding shots is absolutely correct without further movement. When the knack of doing this is mastered, one can shoot faster and more accurately prone than any other way.

The piece may be carried with the sling adjusted to the left arm and held there by slipping down the keeper, in the positions of *trail with the left hand, port arms,* or *ready,* and the *firing* position assumed instantly. With the sling adujsted as shown in Figure 1, the rifle can be instantly slung over the shoulder. In the field and in extended order drills and maneuvers all slings should be habitually kept adjusted in this manner—that is, in the *firing* position.

In firing prone the left hand should grasp the piece as far forward as the length of arm will admit. The farther forward this hand grasps

the less will be the tremble at the muzzle of the rifle. A man 6 feet tall can run his left hand right up against the lower band, and should be required to do so.

To some men the prone position with the sling tightly adjusted is intensely uncomfortable when assumed for the first time. Fifteen or twenty minutes' practice, however, will teach one the knack of it. This must be remembered when teaching recruits to use the sling, and the loop should not be made too loose even at the start. The beginner should be sure to learn the use of the sling. One cannot become an expert without its aid. In company and team practice its use should be made compulsory.

If a man cannot hold steadily when using the sling correctly, the fault can always be traced to his physical condition. My experience as a coach has taught me that during the shooting season men should have strong exercises for the arms, back, and chest daily. The setting-up exercises are not vigorous enough. "Chinning" on the horizontal bar and "dipping" on the parallel bars are excellent. Strength enables one to hold hard and to prolong his holding after the trigger has been pulled.

Summing matters up, the advantages of using the gun-sling are: absolute steadinesss in the

prone position; distribution of the recoil to the entire body; quickening return of the rifle to the target in magazine fire; preventing the rifle recoiling off the target; and minimizing the effect of the wind, fatigue, and breathlessness on holding.

CHAPTER IV.

Holding and Pulling the Trigger.

By "holding" we mean that attempt on the part of the brain, nerves, and muscles to control or eliminate the trembling of the rifle long enough, while it is correctly aimed, to deliver the shot. Hence it will be seen that holding depends upon physical powers. It is impossible to hold a rifle absolutely still by hand. Even the best shots, when firing prone and using the sling, will, if they attach a telescope sight to their rifles, be able to notice a tremble of a few inches on the 1000-yard target. Trembling or poor holding is, of course, most noticeable among beginners, and gradually a man learns control and his gun steadies down.

Thus it would seem that men of a phlegmatic nature have a great advantage over nervous individuals. While this is so to a great extent, it is by no means the general rule. Dr. W. G. Hudson, one of the most expert marksmen in the country, says: "Much has been said about the ability to shoot well being due to 'strong

nerves'—whatever that may mean. Riflemen often refer to an anticipated day's shooting by saying they are 'going to try their nerve.' According to my observation as a physician, however, nerve has little to do with it. I have had expert riflemen under my care suffering from pronounced neurasthenia—the very word means weak nerves—and they could, even during the height of their disorder, shoot almost if not quite as well as when they were in good health." The trembling, of course, lies in the muscles, and anything which tends to give better control over and education of the muscles will improve the shooting. Men who from their youth have been laborers and rough farm-hands will at the beginning, as a rule, make very poor shots. They have never learned that nicety of muscular coordination which is necessary. When a man is clumsy, carries himself badly, is slow in learning the manual of arms, etc., he will, unless educated to shooting from his boyhood, make a very indifferent shot. Mechanics, carpenters, and gymnasts, on the other hand, can be coached into good shots very quickly, for they have learned to control their bodies.

Some men learn to put their whole will into the control of certain muscles, and they are able to hold the rifle in the hip-rest, sitting, and prone

positions, so that no motion to the piece can be noticed by the eye. The trouble now comes with pulling the trigger, for the whole body, including the trigger finger, is "frozen," as it were, and when the finger starts to exert its pressure, the whole rifle moves. The brain is incapable of concentrating its whole will on two things at the same instant. Thus while the rifle is held correctly with the top of the front sight just grazing the lower edge of the bull's-eye, the rifleman's brain will telegraph a message to the trigger-finger to pull. But something else has happened in the meantime. When the thoughts and control of the will were taken away from the holding and turned to the trigger-finger, the rifle was cast adrift without a guiding rudder, and if we were quick enough, we could see the sights drift off that little vital spot just before the recoil shut out the view of the target. This little fault must not be confused with flinching or jerking the trigger, for it must of necessity exist in everyone and can never be altogether eliminated.

There are two ways of pulling the trigger of a military rifle. One is to gradually increase the pressure ounce by ounce until the gun suddenly goes off, in the meantime holding the best you know how, the report and recoil coming in the

nature of a surprise. The other is to learn to put just so much pressure on the trigger that an ounce or so more placed on very carefully at the exact instant when it is desired to fire will discharge the piece. Both methods have their advocates. I believe the latter to be the best way, for we thus have the rifle go off when we want it to, whereas by the former method we limit the accuracy to the average error of holding while applying the pressure. Rapid fire forms such a large part of a rifleman's practice to-day that a man should be able to fire his rifle the instant he sees that his aim is correct. However, the former method is a great factor in teaching a man to overcome flinching, and it is perhaps better to teach recruits to fire in this way, and then, when they have overcome all tendency to flinch, change them to the other method. Jerking or snatching the trigger is, of course, fatal to good shooting. Control of the trigger is everything in rifle practice. It is that part of the art which is soonest forgotten. When we change to a rifle with a different trigger-pull, we must learn it all over again. Hence we should stick to one rifle as long as it remains accurate, and by daily trigger-pull exercises accustom ourselves to the pull and keep in practice.

Flinching is the quick setting of the muscles

at the instant of pulling the trigger to brace against the recoil. It comes from an instinctive dread of the blow of the recoil or from a nervous fear of the report of the rifle. I have seen men flinch so much that they failed to hit a 16-foot square shield placed 30 feet in front of the firing-point. Until this is conquered, of course, a man cannot shoot at all. It seldom demonstrates itself in gallery practice, but we will always find one or two men in a company who do it every time when firing the service cartridge, and who do not seem to be able to be taught otherwise. The remedy lies with the man himself, and if we cannot infuse into a flincher enough interest in the subject to make him work for his own improvement, we nearly always fail to eliminate it by our own efforts or by any system of instruction. In trying to help a man over this difficulty, start with gallery ammunition, then reloaded short range ammunition, then use mid-range ammunition with a small recoil, and finally full service charges. Never let him use the more powerful ammunition for even a single shot until he has conquered the flinching habit with the less powerful loads. Insist upon a gradual and even pressure of the trigger. Be right alongside the man at the firing-point where you can speak to him in a low voice without anyone else hear-

ing. Encourage him, and be sure, above all other things, not to antagonize him. You must exert your whole being to dominate the man so that at the instant of firing, his whole will-power, thought, and attention are concentrated on aiming carefully, holding steadily, and pulling the trigger gradually; so that the factors of recoil and report are blotted from his mind. Two or three good scores obtained from a poor shot in this manner will in all probability cure him of flinching and he will quickly be shooting up with the best shots. I know of no harder work for a coach than this. If the proper amount of will-power is concentrated on the flincher to get a good score for him, the coach will be pretty well exhausted.

I remember a private in my company who was one of the worst flinchers I ever saw. When he first came to the range, I started him in at 100 yards; 30 feet in front of the firing-point was a protective screen 16 feet square with a 2-foot window in the center, through which the target could be seen. Sometimes he hit that screen and sometimes he did not, and although he fired forty shots, he did not get a single bullet through that window. The man persevered, and so did I. He was made of the right stuff, and by the end of the season he was a fair shot; but it was

awfully hard work. The next year he qualified as a sharpshooter and shot on two winning teams.

We have seen how the physical powers enter into holding and pulling the trigger. It therefore follows that anything which tends to improve or injure the physical condition will affect shooting to some extent. By cutting out smoking and drinking and taking up gymnastics, outdoor exercise, and a careful diet, we improve our bodies; but a sudden change of this kind will always hurt a man's shooting until he has become accustomed to the change. The time to institute such a reform is long before the shooting season starts; otherwise, moderation should be the keynote of all habits. A strong, muscular man will always have an advantage over a weak man in military shooting. The weak man may be able to shoot a score or two as well as his stronger brother, but the latter can hold so hard that the recoil is scarcely felt, while the former will be so kicked around that as the shooting progresses his work will fall off. In competitions like those in the regular Army, where the competitor has to compete at his post for top score and then go through two severe competitions of six days' duration each, strength becomes an

enormous factor. So, too, in a strong wind the powerful man can hold his rifle more firmly against the wind than the weaker one. A tall man has a similar advantage over a short one.

CHAPTER V.

Position and Aiming Drills.

Position and aiming drills are the A, B, C of rifle practice. Not only are they necessary in recruit instruction, but they should be included in the every-day work of the most expert. They practice one in the holding, the sighting, and the pulling of the trigger. They educate and harden the muscles and teach control. Starting a recruit in with this form of instruction, the coach is able to correct poor positions and teach good ones.

A recruit must first be taught to see his sights correctly. There is no better system of instruction in this than that laid down in the Firing Regulations. This form of instruction, however, gets monotonous after a time, and men should be kept at it only long enough to qualify. I believe the half sight and the peep sight should be the only ones taught, and one or the other of these methods of sighting should be insisted upon. The use of the peep sight should be encouraged. This sight is used almost exclusively by

FIGURE 10.
Correct Appearance of the Open and Peep Sights in Aiming.

nearly every expert shot in the country. With it the same amount of front sight is seen each time, thus eliminating the vertical errors in shooting. In different lights more or less of the front sight will be seen when using the open rear sight, no matter how careful the rifleman is to see the same amount each time. Thus with the open sight we have to be continually making allowances for light. With the peep sight, however, the light question becomes much simpler. To use the peep sight correctly, the top of the front sight must be exactly centered in the middle of the aperture and the front sight held just under the bull's-eye, as in Figure 10. The eye has a natural aptitude for centering objects, and with a little practice the top of the front sight will be centered exactly without effort. The middle of an aperture always has more light than the sides, and this also aids the centering. If we were to draw the top of the front sight down to the bottom of the peep-hole, we would have less light, and consequently poorer definition, and we would be unable to see the same amount of front sight each time.

Some men have difficulty in seeing the bull's-eye distinctly when aiming. It may appear gray and blurred. In this case center the bull's-eye in the peep sight, instead of the front sight; bring-

ing the front sight to its correct position relative to the bull's-eye.

The open sight should never be wholly disregarded, as many target shots often do. In the field the open sight will have to be used in dim lights and against certain kinds of targets.

When the recruit has qualified on the tripod in correctly seeing both open and peep sights, he should pass on to the position and aiming drills, his first work in this being under the eyes of an expert instructor and his positions being carefully corrected until he can assume them correctly as laid down in the chapter on "The Firing Positions." The recruit is then encouraged to undertake the trigger-pull exercises, and afterwards the rapid-fire exercises in all positions. He should be taught the great value of these exercises not only to the beginner, but also to the expert who desires to keep in practice.

Gloves should not be worn during these drills. The instructor must insist that the men put all their will-power into holding steadily, sighting correctly, and pulling the trigger without disturbing the aim. Each man should use his own individual position when firing standing and sitting, but when firing kneeling or prone the standard positions as given in Chapter III. should be insisted upon. The use of the gun-sling should

be made optional in the standing position and compulsory in all the others. The men should be taught to take up all the preliminary pull or safety creep of the trigger with the forefinger as they raise the rifle to the shoulder. Canting the rifle should be carefully watched for and corrected. It is best to allow the men to go through the exercises "at will," instructing them to continue until they become tired or unsteady, and then to rest a couple of minutes before resuming.

In a company the men should be taught to take advantage of every opportunity to aim at some definite object, pulling the trigger each time. To this end the men's barracks should be furnished with aiming targets. These should be small targets of the same color paper as the regular range targets with the bull's-eye or rapid-fire figure inked on them with India ink. Targets should be made to resemble all the targets used on the range in the regular season's practice, and they should be of such a size as to subtend the same visual angle as do these targets. Place those resembling the short-range targets at 4½ feet from the ground for use in the standing position, and others 20 inches from the ground for use sitting and kneeling. The mid, long, and skirmish targets should be placed 12

inches from the ground or floor for use in firing prone.

In these exercises the first exercise or "position exercise" is intended to develop the muscles used in holding the rifle. To this end it should be given as an exercise, and not as a drill; that is, the exercise should be kept up just to that point where the muscle tires, in order that development may result. Also it should be given last, as otherwise the men's muscles will be too tired for steady holding in the aiming and trigger-pull exercises.

The beginners should be made to understand that rifle-shooting is a complex science which requires a large amount of intelligent practice, and that they cannot master it in a few days or even in a season's practice. If a man is left to make this discovery for himself, he is liable to become discouraged long before he reaches that degree of proficiency where his interest begins to rise with leaps and bounds. I have been shooting a rifle since I was a very small boy, but never have I seen the time when I could disregard the position and aiming drills.

CHAPTER VI.

Gallery Practice and Calling the Shot.

Gallery practice is taken up next after the position and aiming drills have been thoroughly taught. It consists in shooting at short range, 50 feet to 50 yards, with service rifle with .22-caliber barrel or the regulation rifle with a reduced load. It offers a different and more interesting form of instruction than the position and aiming drills, with the same object in view—*i. e.*, instruction in position, holding, sighting, and control of the trigger. It is well to start the recruit in at 50 feet on the iron target, for at this range he can see the shot marks and the practice goes along quickly. After he has become proficient at this range, he should be moved up into the class firing at 50 yards and taught to "call his shots." This is where the great benefit of gallery practice comes in. *Until a man can call his shots he is a very poor marksman, and indeed he cannot be coached into a better one.* By "calling the shot" is meant the telling the in-

structor by the marksman the exact point on the target upon which the sights were aligned at the instant the rifle exploded. The marksman must form the habit of holding as steadily as possible and gradually increasing the pressure on the trigger, and then, just at the instant the gun goes off, he must catch in his mind a picture of where the sights were aligned, where the rifle was aimed, at that instant. The recruit cannot hold steadily; his front sight seems to wander aimlessly over the bull's-eye and four rings of the target while he tries to pull the trigger off carefully; then suddenly the recoil shuts the target from view. It is the point where the top of the front sight was the quarter-second before the recoil shut it out of view that should be called. Immediately after having fired, he calls to the instructor where he held or where he expects his shot to go, thus: "A '4' at 3 o'clock," "A bull at 7 o'clock," "A bull in the center," "A good hold a little towards 5:30 o'clock," or, "I got off just right," "A trifle low," "At 7 o'clock," etc. If the rifle is correctly sighted and the man has called his shot correctly, the bullet should hit the target at the spot the man called. If it does not do so and the man is sure of his call, he should alter his elevation and wind-gauge an amount corresponding to the distance and direc-

tion of the hit from the point of call. Or, if he is sure that the gun was correctly aimed to hit the bull's-eye in the center and his shot is marked a "4" at 8 o'clock, he must raise his elevation enough to make the next shot fall in a horizontal line intersecting the center of the bull's-eye, and move his wind-gauge to the right enough to make the next shot fall in a vertical line intersecting the bull's-eye. Then, if the next shot is correctly aimed, it should hit dead center.

Under no circumstances should a man be allowed to hold on any part of the target other than the bull's-eye to correct an error in sight-adjustment. The sight must always be moved to correct this error. One should always hold with the front sight just below the bull's-eye at 6 o'clock. The front sight should not touch the bull's-eye and a little strip of white target should always show between the top of the front sight and the bottom of the bull's-eye. This strip of white should be of equal thickness for each shot, as in Figure 9. It is of the greatest importance that men be taught to always aim in this manner, and it must be thoroughly impressed upon them at the very beginning of their instruction. So important is this that, when discovered, any departure from this iron-clad rule

should be an occasion for strict disciplinary measures.

A recruit should never, if it can be avoided, be allowed to take up range practice until he has learned to call his shots; otherwise it is simply a waste of ammunition. It is necessary in teaching this that the target be removed to such a distance that the men cannot see the bullet-holes; otherwise they will call them instead of their points of holding. For the same reason the target should not be marked for about ten seconds after the shot has been fired. The bright men of the company will learn to call their shots very quickly; others may take a long time to learn it. It is thus well to start gallery practice very early in the season, so that all men may be qualified before the time for range practice. Too much gallery practice cannot be given. Interest may be kept up by competitions, prizes, and privileges for the best shots.

The regulation gallery rifle is the .22-caliber U. S. Magazine Rifle, Model 1903, using the .22-caliber short smokeless cartridge. It is exactly the same as the regular rifle, except that it has a .22-caliber barrel. The cartridges are loaded into "holders," which are steel chambers similar in shape to the regular cartridge. These holders are loaded into the rifle in exactly the same man-

ner as the regular cartridge, and the rifle can be used as well for rapid fire as for slow fire. The rifle is extremely accurate at 50 feet, the range for which it is intended. The ammunition is very cheap and has a penetration at this range of about 4 inches in dry pine. The arm is a most excellent one for the purpose for which it was designed—namely, for gallery practice in the instruction of recruits. It has the same action, sights, balance, and feel as the regular service rifle and is loaded in the same manner, making one perfectly familiar with the rifle he will use in the regular season's practice and in the field.

The finished expert, however, will not be fully satisfied with this rifle for his winter work and gallery practice in keeping in form. It is not *accurate* enough at ranges over 50 feet to do justice to the holding of a really good shot, and such men quickly lose their interest in work with this rifle. There are two gallery rifles on the market at the present time using .22-caliber ammunition which are accurate enough up to 200 yards to fulfill the requirements of the most exacting. One is the Krag rifle, fitted with a .22-caliber Stevens-Pope barrel by the J. Stevens Arms and Tool Company of Chicopee Falls, Mass. The riflemen must furnish his own Krag

action, stock, sights, etc., the Stevens Company furnishing only the barrel, and mounting it in the action. Many of the States have procured and adopted this rifle for gallery practice. The other rifle is the .22-caliber Winchester, single-shot rifle, equipped with the same sights as the Krag rifle (Model 1901, rear sight) and having a musket stock. It is made by the Winchester Repeating Arms Company of New Haven, Conn. Both these rifles use the .22 long rifle cartridge (not to be confused with the .22 long, which is an inferior cartridge), and they will shoot accurately enough to group ten shots inside a half-inch circle at 25 yards, or in fair weather will place all their shots in the regulation bull's-eye at 200 yards. Black powder cartridges of standard make are better than those loaded with smokeless powder. Smokeless powder has a very corrosive effect in .22-caliber rifles. The cleaning should immediately follow any use of the rifle and ought to be very thorough, using "Powder Solvent No. 9" if possible, and it should be repeated daily for several days. These special gallery rifles are not adapted to magazine fire, and are not as suitable for company work as the regulation .22-caliber rifle.

The gallery rifle has one disadvantage, however, in that the marksman using it does not

become familiar with the trigger-pull and feel of his own rifle—the one he will have to use on the range and in the field. Gallery practice is not to be considered only for recruit instruction. It is of great value to the good shots also. The latter can, by its aid, keep up his practice during the winter months and in inclement weather. There is a saying, "Beware of the man with one gun," which is a mighty true one. To become really expert with the rifle, one must use his piece until it becomes almost a part of himself; must know its trigger-pull, bolt, action, feel, balance, sights, and peculiarities as he knows the alphabet. Thus the very best can be obtained from gallery practice only when one uses in it the rifle he intends to use on the range and to stake his reputation on. Reloading reduced ammunition for the .30-caliber barrel was tried in the regular Army for years and was never satisfactorily done in a company, and for such use it is not recommended. To produce a satisfactory short range .30-caliber load requires special tools and great care, and is indeed a special study in itself. The load must be accurate enough to do justice to the holding of a good shot. In other words, it must be capable of shooting into the same hole at 50 feet or into a 1-inch circle at 50 yards. It must not wear the barrel, and must

not be too strong for indoor use. It must also be cleanly enough to use without having to clean the rifle during the practice. The loading of reduced ammunition is discussed in Chapter XVII. These loads have also the advantages that they can be used for rapid fire and are almost as cheap as the .22-caliber ammunition. Many of them are accurate up to 200 yards and even beyond. A .22-caliber rifle cannot be used with satisfaction at ranges over 50 yards in high winds. With reduced ammunition one can also use a miniature skirmish range exactly similiar to the regular range, but the targets, halting-places, etc., reduced in proportion, so that the range will have a total length of 200 or any other number of yards.

Gallery ranges are easily made. Bullet-stops may consist of 10 inches of wood, sand-bags, or a ¼-inch iron plate. The regular iron target issued by the Ordnance Department may be used, or preferably paper targets tacked on a wood framework set up just in font of the bullet-stop. Or you may go all the way to a miniature range exactly like the regular range, with butts, markers' shelters, sliding target frames, and wind-flags. Indoor targets may be lighted by lamps with reflectors placed just in front of and to one side of the target, so that their light will be

thrown thereon. The best galleries are fitted with a trolley arrangement whereby the targets can be run down to the butt and back to the firing-point by hand, thus obviating the necessity of having a man near the target. The location of bullet-holes can be ascertained by having a cheap, powerful telescope trained on the target and rigidly fixed alongside the firing-point.

If reduced loads are used, steel plates may be set behind the targets at an angle of 45 degrees, thus throwing the bullets down into a sand-box below, where they can be gathered up and remoulded, thus making a saving in lead.

CHAPTER VII.

The Sights and Their Adjustment.

The front sight of the service rifle consists of an immovable piece of steel like a knife blade. When viewed from the rear, the top appears square and has a uniform thickness from base to top of approximately .05 inch. It is secured to the front sight movable stud by a pin. The front sight movable stud is secured to the front sight stud by a slot. The rifle is targeted at the arsenal and the front sight movable stud is adjusted laterally in this slot until the rifle shoots correctly with the wind-gauge of the rear sight set at zero. A screw is then run through the stud into the movable stud, holding the latter immovable. The front sight also is made higher than necessary at the arsenal and is filed down during targeting until the rifle shoots correctly. This targeting is done at 200 yards, and the rifle as sent from the arsenal shoots correctly at that range with the rear sight elevated to 200 yards and the wind-gauge at zero. However, as we will see later, peculiarities in eyesight or aiming

may make a slightly different adujstment necessary with some men.

The present rear sight is known as the Model 1905 and has adjustments both vertically and laterally for elevation and windage. When the rear sight leaf is raised, three sights appear. The upper open sight is adjustable for ranges from 1400 to 2775 yards. The lower open sight in the triangle of the drift slide is adjustable for ranges from 100 to 2450 yards. The peep sight in the lower part of the drift slide is adjustable for ranges from 100 to 2350 yards. There is also an open sight on the extreme top of the leaf for 2850 yards, being the extreme range for which the rifle is sighted. The leaf is so designed that as the slide is raised for increased ranges the drift slide moves laterally to the left to correct for the drift of the rifle. When the leaf is laid down flat, an open sight only appears, which is known as the "battle sight." This sight is permanently fixed for 530 yards, or about the danger space of the rifle. The wind-gauge graduations appear just to the rear of the leaf, each line of the graduations being called a point, and each third line being longer than the others. The wind-gauge is actuated by the windage screw at the forward end of the base. The leaf is graduated from 100 to 2850

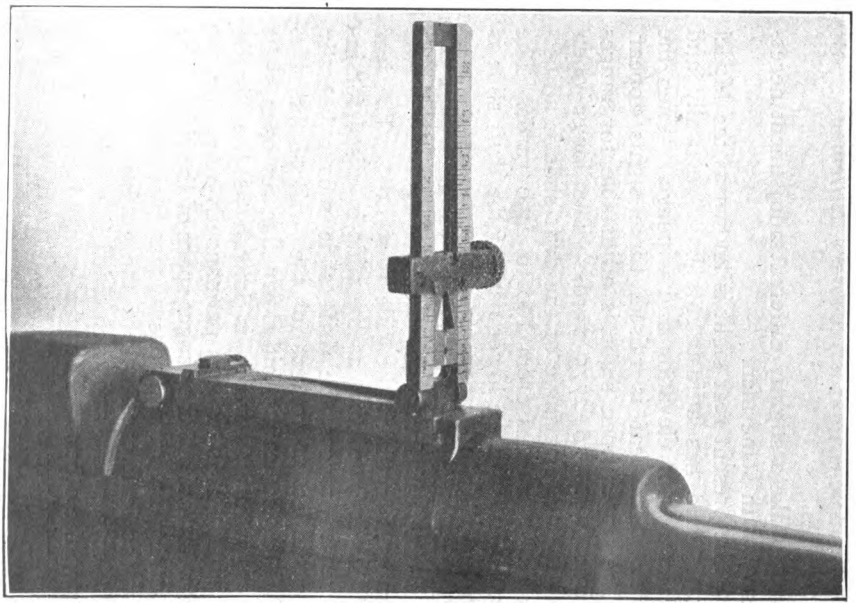


FIGURE 11.—Model 1905 Sight.

yards, the graduations for the odd-numbered ranges being on the right and those for the even-numbered on the left. A reference to Figure 11 will make this description clear.

Next to the muzzle, the sights of a rifle are its most delicate and important part, and all men should be taught to guard them with the greatest care, especially from blows which would knock them out of alignment.

Accuracy in the setting of the sights is of the greatest importance in good shooting. The front and rear sights are 22.1254 inches apart, which distance is called the "sight radius." Now if we move the rear sight up or down a distance of 1-150 inch, we will move the bullet or hit on the target approximately 1 inch (actually 1.084 inches) for every 100 yards of range. That is, a change in elevation of 1-150 inch will raise or lower the position of the hit on the target 2 inches at 200 yards, 5 inches at 500 yards, or 10 inches at 1000 yards. In like manner we may find what any move on the sight will give on the target by the formula:

$$\frac{\text{Movement of Sight in inches} \times \text{Range in inches}}{\text{Sight radius (22.1254 in.)}} = \text{Move of hit on target.}$$

An adjustment of sights to the fineness of 1-150 inch is almost absolutely necessary in fine target work, but there are very few men indeed who can see to elevate or lower their sights an amount even as small as .01 inch. The distance between elevation marks can, however, readily be divided into four equal parts, giving an elevation reading to 25 yards. Consulting the table of sight-adjustments at the end of this chapter, we will see that if we are shooting at 500 yards with a sight elevation of 500 yards, and we raise our elevation to 525 yards, our next shot will strike 6.2 inches higher than the preceding one.

A rifle will seldom be found which will hit the bull's-eye in the center with the sights set at the exact elevation for the range. The difference in temperature and barometer from that prevailing on the day at the arsenal when the rifle was targeted, the difference in the velocity and fit of ammunition, of light, of peculiarities in aiming, the effect of mirage on the target, metal fouling in the bore, and the personal equation of the rifleman are all causes which may make as much difference as 100 yards in the elevation required for a certain rifle and man. Thus an individual may find that when shooting at 500 yards his sights will have to be set at an elevation of 575 yards in order to make a center bull's-eye when aiming and pulling the trigger correctly.

Most expert riflemen have found it far better to use a small instrument called a "micrometer sight-adjuster" in adjusting the sights for elevation than to rely on the uncertainty of adjusting them by eye and hand. These instruments snap on the sight and by means of a micrometer screw and scale can be adjusted to read 1-150 inch; thus the sight can be elevated to read inches on the target, and the very fine adjustments can be recorded and the sights accurately set at them again. This is a great advantage in fine target work. For instance, a man finds his average elevation for 600 yards to read 38 minutes on the micrometer. He fires his first shot with his sights set at 38 minutes and it strikes 18 inches below the center of the bull's-eye. Now if he raises his sight 3 minutes, or from 38 to 41, using the micrometer, he knows positively that if he gets his shot off the same as the first one, other conditions being the same, it will strike 18 inches higher, or in the center of the bull's-eye, for 1 minute or 1-150 inch additional elevation will raise his shot 6 inches at 600 yards. His correct elevation at 600 yards may be 38 minutes, corresponding as nearly as he can see to a reading of 640 yards on the sight; but without the micrometer he cannot be positive that he sets his sight at exactly this point.

It has been often asserted that the micrometer

sight-adjuster is not a military instrument, that it could not be used in the field in action, and that its use should therefore be prohibited. Let us take the time here to look into this matter a little. Without the micrometer the error of setting the sights will be about .01 inch, that having been found to be as close as the human eye unaided is capable of making an adjustment. It has also been found that the error of the human eye in aiming with non-magnifying sights is just about 1 inch for each 100 yards, or 5 inches at 500 yards and 10 inches at 1000 yards. To these we must also add the mean vertical and horizontal deviation of the rifle or the radius of the shot group, and we get the following table of approximate accuracy of the rifle:

Range. Yards.	Error of Sight Adjustment. Inches.	Error of Aim. Inches.	Mean Vertical and Horizontal Deviation. Inches.	Approximate Accuracy of Fire Radius of Shot Group. Inches.
100	1.62	1.	.8	3.42
200	3.24	2.	1.6	6.84
300	4.86	3.	2.4	10.26
400	6.48	4.	3.3	13.78
500	8.10	5.	4.2	17.30
600	9.72	6.	5.1	20.82
700	11.34	7.	6.	24.34
800	12.96	8.	7.	27.96
900	14.58	9.	7.9	31.48
1000	16.27	10.	8.9	35.17

From this table it will be seen that the best shots, unaided by so-called "refinements," will not be sure of hitting a man lying down at 400 yards, or of hitting the regulation bull's-eye at any range, and if he does his very best, he will just be able to keep all his shots on the target at 1000 yards. It would certainly seem that the Nation will never be satisfied with this degree of accuracy for its riflemen. The use of the micrometer sight-adjuster eliminates the greatest source of this error and shows the great need of this instrument even in the field, or, better still, of a slight modification of our otherwise perfect sight having a simple micrometer adjustment incorporated in it. One sight modified in this manner has already been made by the Ordnance Department and the prospects for its adoption seem very good. The table also shows the need of a telescope sight which would eleminate the error of aim, and the accuracy of the rifleman would then depend only on the uniformity of the ammunition.

There are three forms of micrometer sight-adjusters on the market at present: the Stevens-Pope Sight Micrometer (see Figure 12), which snaps on the sight and is held by springs, procurable from the J. Stevens Arms and Tool Company, Chicopee Falls, Mass.; the British Sight

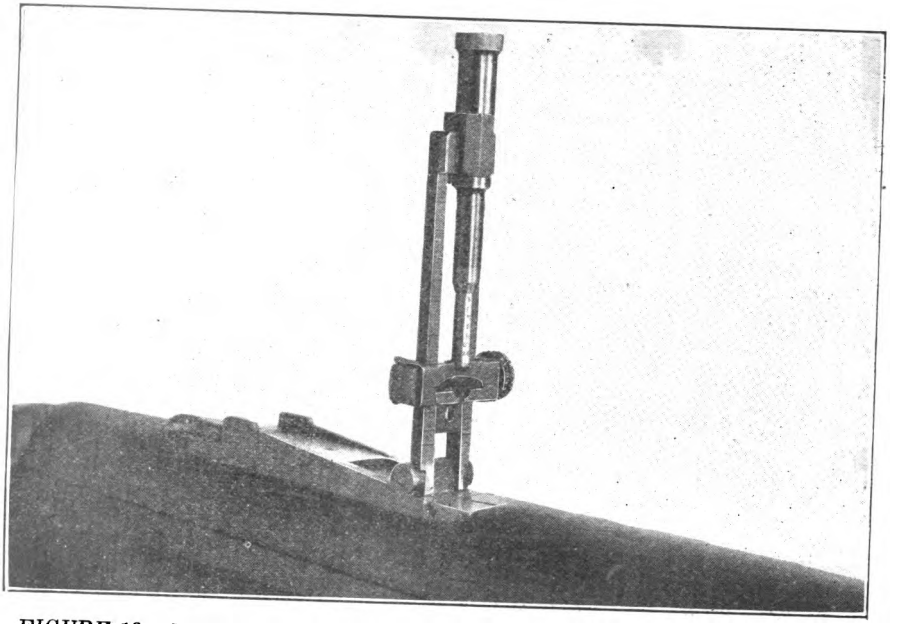


FIGURE 12.—Model 1901 Sight, with Stevens-Pope Micrometer Sight-Adjuster.

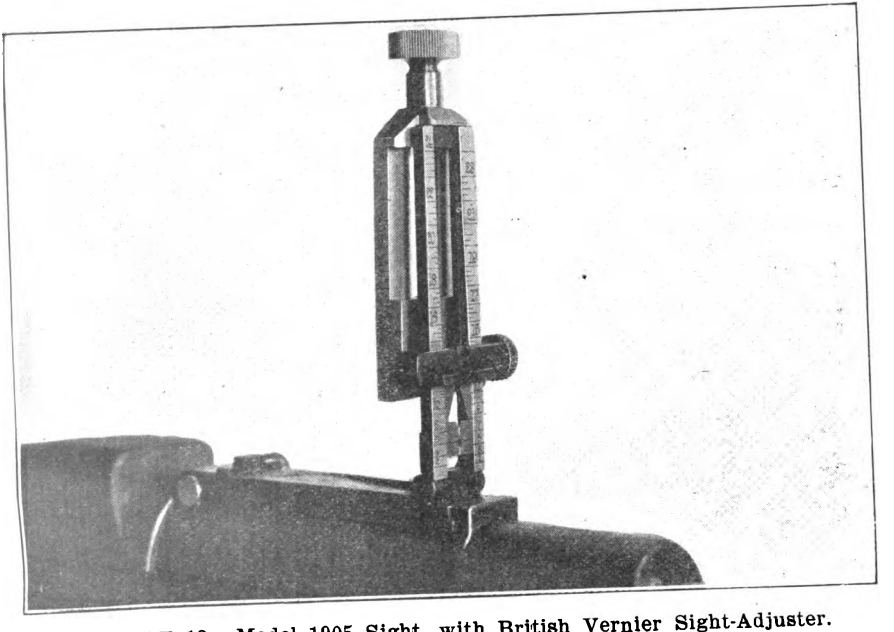


FIGURE 13.—Model 1905 Sight, with British Vernier Sight-Adjuster.

FIGURE 14.—The Ideal Micrometer Sight Gauge.

Vernier (see Figure 13), sold by Thomas J. Conroy, 28 John Street, New York city; and the Ideal Micrometer Sight Gauge (see Figure 14), made by the Ideal Manufacturing Company, New Haven, Conn. H. M. Pope, of 18 Morris Street, Jersey City, N. J., has also made a few micrometers of most excellent design and workmanship.

So far, we have considered only the elevation adjustment of the sight. The windage adjustment, however, is of just as much importance. It gives the correction for horizontal errors and the allowance to compensate for the effect of wind on the flight of the bullet. To move the location of the hit to the right, move the wind-gauge to the right, and *vice versa*. The divisions on this wind-gauge are called "points," and for convenience are divided into series of three. On the Model 1905 Sight these points are 0.0267 inch apart; therefore, moving the wind-gauge 1 point will move the bullet 4 inches on the target for every 100 yards of range, as will be seen in the table of sight-adjustments. It sometimes happens that the zero of the wind-gauge is not the true zero of the rifle, for the same reasons that a rifle does not always shoot correctly with the rear sight adjusted for the exact range. Some rifles may have to have the wind-gauge

adjusted to as much as 1 point right or left of the zero on the scale to shoot into a vertical line drawn through the center of the bull's-eye when there is no wind blowing and the gun is correctly aimed. Up to the present time no micrometer adjuster has been made for the wind-gauge, and experience has proven that it is not so much needed here as on the elevating scale. A point on the wind-gauge can easily be divided into quarters by the eye alone and this will give an adjustment of 1 inch at the target for each 100 yards of range. One-fourth of a turn of the wind-gauge screw will move the wind-gauge 1 point, and one-sixteenth of a turn will move it one-fourth of a point, which is the same adjustment that 1 minute on the micrometer gives.

Let us take an example of sight-adjustment. Suppose the rifleman is firing at 800 yards with an elevation of 825 yards and a windage of 2 points to the left. On the first shot he gets a "3" at 10 o'clock, and the location of this shot appears to be 20 inches above the center of the bull's-eye and 33 inches to the left of the center. If he now reduces his elevation 33 yards, or to 792 yards, and moves his wind-gauge 1 point to the right, or to 1 point left (see "Table of Sight-Adjustments"), and if the weather conditions remain the same and he gets his shot off

correctly, he should get a hit very near the center of the bull's-eye. Of course, one cannot adjust his elevation to any such reading as 792 yards, but he makes a try at it, and gets it just a hair's breadth below 800 yards, and has to be satisfied with that. He may have struck the correct elevation, or he may be as much as a foot out.

If he was using the micrometer adjuster and his elevation for the first shot read 49 minutes, he would reduce it to 46½ minutes to lower the next hit 20 inches, which would give exactly that result.

If, however, the rifleman was ignorant of the value of movements on the sights—that is, if he had no "Table of Sight-Adjustments" and no micrometer, he might make too large or too small a move, and instead of getting a bull for his second shot, he would be just as liable to get a "3" or a "4," and a continuation of this kind of guesswork would ruin his score. Thousands of scores and hopes for high qualifications are ruined every year in this manner. Given good muscles and good eyes, all men soon learn to hold fairly steady, especially in the prone position. There is really very little difference between the holding of a first-class shot and a very poor shot who has been taught to assume a fairly correct

position. The good shot, however, calls his shots and moves his sights the correct amount, and after the first shot or so gets mostly "4s" and "5s"; while the poor shot scatters all his shots over the target and perhaps gets a couple of misses. We thus see the great importance of fine and accurate sight-adjustment and the value of the tables given. *The shooting of a modern rifle is just as much a matter of education and study as it is of good holding, aiming, and pulling trigger, and this point must not be overlooked in the selection and training of recruits.*

Another great advantage in using the micrometer is, that having found the correct elevation for one range, we can tell almost exactly, by reference to the "Table of Rises of Elevation on the Micrometer," what the elevation for the other ranges will be. Thus if we have been firing at 600 yards for the first time with a new rifle and have found the elevation to be 38 minutes, and we then desire to fire at 800 yards, never having fired the rifle there before, we will see from the table that if we raise our elevation 12 minutes, or to 50 minutes, we will have almost exactly the right elevation for that range. This is particularly advantageous in getting elevations for a skirmish run, a few trial shots at 200 and

600 yards giving the data from which the elevations for all the ranges can be worked out.

To be well defined to the eye without blur or glimmer, the sights must not be bright, and to show up well against the white target in aiming, they should be black. To obtain this dull black color, most riflemen smoke their sights in the smoke of a candle or a small piece of camphor. Some riflemen prefer to paint their sights with a liquid sight black. Dr. Hudson's formula for sight black is as follows:

Ivory black "B" in japan (a black paste, obtainable from dealers in painters' supplies in 1-pound cans), 5 ounces.

Gasoline, 76 test, 12 fluid ounces.

Add the gasoline little by little to the paste, mixing thoroughly after each addition. If it is found to dry with any gloss whatever, there is too much "binder" in the paste; to correct this, add to the paste a little powdered lampblack and work up thoroughly with the first portion of the gasoline, which is added. Gasoline is used to thin down the paste because of its quick-drying properties. This mixture will dry on the sights in a few seconds.

If the sights are smoked, they should be wiped free of all oil, and the elevation and windage scales should be carefully wiped free of black, so

that they can be easily seen. No good work can be done with bright sights, and men should never be allowed to come to the firing-point without their sights blackened.

Table of Sight-Adjustments.

Model 1905 Sight.

Range. Yards.	Value on the Target of a change of 25 Yards in Elevation. Inches.	Value on the Target of a change of 1 Point in Windage. Inches.	Value on the Target of a change of 1 Min. of Micrometer Elevation. Inches.
100	0.7	4.	1.
200	1.6	8.	2.
300	2.8	12.	3.
400	4.3	16.	4.
500	6.2	20.	5.
600	8.6	24.	6.
700	11.6	28.	7.
800	15.4	32.	8.
900	19.9	36.	9.
1000	25.1	40.	10.

Table of Rises of Elevation on the Micrometer.

For ammunition manufactured at the Frankford Arsenal with 150-grain sharp-pointed bullet at 78 feet from the muzzle, of about 2640 feet.

From	200	to	300	yards	rise	3.′	with micrometer.
"	300	"	350	"	"	1.7′	" "
"	350	"	400	"	"	2.′	" "
"	400	"	500	"	"	4.′	" "
"	500	"	600	"	"	4.3′	" "
"	600	"	800	"	"	12.′	" "
"	800	"	900	"	"	7.′	" "
"	900	"	1000	"	"	8.′	" "

CHAPTER VIII.

Elevation and Zero.

We have seen in the previous chapter that a gun is seldom correctly sighted for a given range at the exact elevation as marked on the sight. A rifleman shooting a new rifle changes the elevation on his sights until the rifle is shooting steadily into the bull's-eye. He then records the reading on the sight or micrometer as the elevation for that range and for the ammunition he was then using. It is actually a fact, as will be seen later, that ammunition manufactured on different days or on different machines will require different elevations. It is also a fact that different weather conditions will require different elevations with the same man, gun, and ammunition. The expert shot determines the elevation for a new rifle on a day having average or normal weather conditions for the locality in which he is shooting. He carefully records in his score-book, opposite this elevation, the exact weather conditions existing at the time of firing, and it then becomes his "normal elevation," from which he adds or subtracts to obtain

his actual elevation under changed weather conditions. Elevations are subject to many changes, causes for which may be laid to the following:

Differences in ammunition,
Temperature of air and rifle,
Light,
Mirage,
Barometer,
Hygrometer.
Condition of the bore of the rifle,
Condition of the eyes,
Differences in position and hardness of holding.

A rifle also changes its normal elevation from time to time. A new rifle is constantly changing until the bore loses the polish which the tools gave it during manufacture and takes on the polish which the bullets passing through give it. The elevation of a modern rifle remains most constant between the two-hundredth and the twelve-hundredth shot, provided the barrel is well taken care of. The effect of temperature, light, mirage, barometer, and hygrometer upon elevations will be considered later. Most guns which are bored near the standard size (.308 inch) have certain peculiarities of grouping their shots. If the barrel is clean and coated with oil, the first shot will go quite a little higher

than the succeeding group and perhaps a trifle wild. This is owing to the lubrication in the bore, which is burnt out after the first shot. After the first shot the gun will group its shots very steadily in one spot. If the barrel be clean and perfectly dry and free from oil, or if it be clean, dry, and the bullet coated with Acheson graphite, there will be no difference between the point of impact of the first and succeeding shots. A rifle having the bullets coated with Acheson graphite will require a trifle lower elevation than when the graphite is not used. If the rifle is fired very rapidly and the barrel gets very hot, the bullets will strike higher.

It used to be thought that a shot fired from a clean, cold, dry barrel would go higher than the succeeding group. I have watched carefully for this during the last four years of practice, and have been unable to find any difference between the point of impact of a clean, cold dry barrel and the same barrel where fairly warm and fouled.

There seems to be a tendency for some powders to deposit more of a sticky fouling in the bore than others. As this fouling accumulates the shots will drop lower and lower on the target, requiring the sights to be raised. Then perhaps one shot may take out a great bulk of

this fouling and the next shot strikes very much higher. The accumulation of metal fouling will produce the same results. A rifle will shoot a trifle higher, and therefore requires lower elevation, if shot in the prone position than if shot off-hand. It will shoot higher still if the barrel is rested on any object, such as a log, sand-bag, or intrenchment.

There are many exceptions to these statements, however, and the only safe way of determining how a gun will group its shots is to fire seven or eight scores without changing the elevation during the score, plotting them carefully on the target diagram in the score-book, and then comparing.

In determining the "normal elevation" of a rifle, it is best to take it after about 200 rounds have been fired from it, and approximate elevations found. Choose a clear day, with the barometer and hygrometer normal and the temperature about 70 degrees (90 degrees in the Philippine Islands). Choose also a time of day when neither the target nor sights are in the shade, and also when there are no heavy retarding or accelerating winds. A fairly steady deviating wind does not matter. When the rifle is shooting steadily into the bull's-eye, record the elevation,

and with it note all the data as to ammunition and weather; for instance, as follows:

Rifle No. 333166.

Normal elevation for 800 yards—710 yards, = 42 minutes.

Frankford Arsenal Ammunition, November 7, 1907, N. G. S. No. 2 Powder.

Velocity: 2649 feet.

Light: bright sunny, 10 a. m.

Mirage: light.

Thermometer: 70 degrees.

Barometer: 29.30 inches.

Hygrometer: 50 per cent.

Wind: 9 o'clock, 8 miles per hour.

Fort Sheridan, Ill., August 10, 1908.

You have now the exact data for the normal elevation at 800 yards of this rifle and ammunition, and from it you can calculate, in the manner shown later, the change in elevation necessary for other conditions of weather.

By the zero of a rifle we mean that point on the wind-gauge to which the sight must be set to cause the rifle, when correctly sighted, to shoot into a vertical line with the center of the bull's-eye when no wind is blowing. It may be as much as 1 point right or left of the 0 on the scale, and is, of course, the point from which all right and left windage is figured. If, for in-

stance, the zero of our rifle is 1 point right, and the wind indications call for a correction of 1 point right, then we move the wind-gauge to read, 2 points right; but we have only taken a point of actual wind. The zero may differ for different ranges, and it may be to the right for one range and left for another. It may change a little with the changes of ammunition. Changing from full service loads to reduced loads changes it considerably. On the Krag rifle it is often changed permanently when the rear sight is removed and then replaced. A blow on the front sight will often bend it so as to change the zero. Otherwise the zero is not affected by the many conditions which influence the elevation.

The best way to determine the zero is to shoot on days when there is no wind, and carefully record the wind-gauge readings. On some ranges, however, windless days are very scarce. On such a range take a number of correctly pulled shots which have hit the bull's-eye, subtract from their windage data the number of points which the wind at the time of firing called for, and average the results. If the score-book has been carefully kept, the average will be the zero for that range.

When the rifleman knows the normal elevation and zero for his rifle at all ranges, he is pre-

pared for accurate shooting and for competition work. Until these are determined, his shooting must be largely experimental, or, as it is called in the Firing Regulations, "instruction practice." The expert starts the season's shooting with a new rifle. He simply shoots it carefully through the various courses, keeping all the while every speck of data very carefully in his score-book, as shown in Chapter XII. In a very few days he will be able to determine absolutely his elevations and zeros from this data. Some men trust to memory for their elevations, but these men are seldom found among the prize-winners.

CHAPTER IX.

Windage and Winds.

There is nothing which bothers the novice so much when he first undertakes range practice as the wind, and yet to the expert it is a very simple matter. The wind is the greatest disturbing factor to the flight of the bullet that we have to contend with. The effect of a wind blowing on the side of a bullet is to cause it to travel slightly with the wind. Thus, if a wind coming from the right is blowing on the right-hand side of the bullet, the bullet will drift to the left, and instead of the bullet hitting the bull's-eye, it will strike over toward the left-hand edge of the target. To compensate for this, we adjust our wind-gauge to the right. This is all clear enough, but the lack of knowledge of just how much to allow on the wind-gauge for a certain velocity and direction of wind is the stumbling-block to most novices.

In speaking of the direction of the wind, riflemen consider the rifle range as they would the dial of a clock with the target at 12 o'clock and

the firing-point at 6 o'clock. Thus, a wind blowing from the right at exactly a right angle to the line of fire would be called a 3-o'clock wind, and a wind blowing straight toward the marksman would be a 12-o'clock wind. A 3-o'clock wind has the greatest deviating effect on the bullet, and this effect decreases as the direction approaches 12 or 6 o'clock until when in these latter directions the wind causes no lateral displacement of the bullet at all.

The direction and velocity of the wind are shown by its effect on the flags or streamers of red bunting with which every range is supplied. The rifleman judges the velocity by the way the flag stands out with the breeze. For instance, a wind with a velocity of 1 mile per hour gives a barely perceptible lift to the flag, while a 25-mile per hour wind will cause the flag to stand straight out from the staff. Many ranges are also provided with wind-clocks, which are large clock dials with a single hand so geared to a weather vane that when the wind is blowing from a certain direction the hand will point to that direction. They show the direction of the wind with a greater degree of precision than the flags will indicate.

As the velocity of the bullet is constantly decreasing, and the wind will deflect a bullet trav-

eling at a low velocity more than it will one traveling at a high velocity, it follows that the deflected path of the bullet with a lateral wind is a curved line, as in the case of the trajectory. That is to say, if the wind deflects the bullet 1 inch at 100 yards, it will deflect it more than 2 inches at 200 yards, and considerably more than 3 inches at 300 yards, and so on.

The estimation of the velocity of the wind will always remain largely a matter of guesswork. Figure 15 gives approximately the amount of lift which the different wind velocities have on the standard streamer when the streamer is dry. When the streamer is wet or damp from rain, dew, or fog, it will not stand out as much, and flags of different shape, size, and material will stand out differently. If the flags on a certain range do not stand out as shown in this figure, the lift had better be observed and compared with an anemometer and a sketch made of the flags as they lift with the different velocities of wind.

Being able in this manner to judge the direction and approximate velocity of the wind, we turn to the table of lateral wind allowances, and from it are able to set our wind-gauge so that our first shot should be at least a "4."

Let us take an example: We are to fire at 600

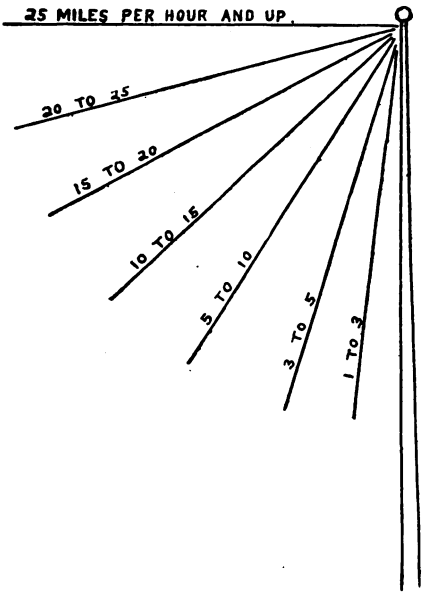


FIGURE 15.
Flag Lifts for Different Velocities of Wind.

yards. We notice that the wind is blowing from 2 o'clock and the flags stand out from the staff at an angle of about 45 degrees, indicating about a 12-mile wind. We refer to the table and find that at 600 yards a 2-o'clock wind at 12 miles per hour will require a correction of 1½ points. We therefore set our wind gauge to read "1½ points right," for the first shot.

We have seen that 6- and 12-o'clock winds do not deflect the bullet laterally, but they do have an accelerating or retarding effect on the flight of the bullet, as also do 1-, 5-, 7-, and 11 o'clock winds, but to a lesser degree. A 6-clock wind, by accelerating the flight of the bullet, will cause it to strike a higher point on the target, and a 12-o'clock wind, by retarding the flight, will cause it to strike lower. The amount of correction to be made for 6- and 12-o'clock winds is given in the "Table of Longitudinal Wind Allowances." Thus, if we are shooting in a 20-mile wind from 6 o'clock and the range is 1000 yards, our bullet will strike 51.4 inches higher than normal and the rear sight must be given a lower elevation—say 5 minutes lower with micrometer. Similarly, if the direction of the wind were 12 o'clock, the bullet would strike 46.8 inches low, necessitating a rise in elevation of about 4½ minutes.

Often the wind will vary greatly in velocity between shots, sometimes doing it so quickly and frequently that is is impossible to follow it by adjusting the sights. In this case the wind-gauge should be set for the average wind and the rifleman should endeavor to get his shot off just when the flag blows out with that velocity. It hardly pays to try to shoot in a wind of over 25 miles per hour. Always observe the flags near the target in preference to those near the firing-point, as the former give the condition of the wind where the bullet's velocity is the smallest and where it is most easily deflected.

Often it happens that the flags will not show the true direction of the wind. They may be influenced by hills, valleys, or a line of trees at the side of the range. In these cases the flight of the dust kicked up by the bullets which strike the butts, the wave of the grass, the flight of small insects, etc., offer valuable guides. The best method of judging the deviating effect of the wind, however, is by the mirage or heat waves. In order to see the mirage with ease, a pair of field-glasses of not less than 10 diameters (10 power) is needed, or, better still, a telescope of from 20 to 33 diameters with an object-glass about 2 inches in diameter. When viewed through these, the mirage will be seen to drift

with the wind. A little experience on the range will soon teach the rifleman how much to allow for a certain drift of mirage. Mirage is extremely sensitive to wind, and shows clearly every change and current. The flags show the wind high up in the air and off to one side of the range, but if the telescope be focused on the target, the wind indications shown by the mirage will be those directly in the path of the bullet. Experts have come to disregard the flags to a great extent and depend on observance of the mirage for wind judgment. On the Fort Sheridan rifle range, I have seen the flags giving an indication for 2 points right wind when the mirage showed indications for 1½ points left. Upon firing it was seen that the mirage indication was the correct one. It often happens, however, that mirage is not present, and then the flags have to be relied upon.

CHAPTER X.

MIRAGE, LIGHT, AND ATMOSPHERE.

Mirage.

Mirage is that rippling haze or waves of heat which is so much in evidence when looking across ground heated by the summer sun. The effect of mirage is to deflect the image of the target vertically, laterally, or both together. When no wind is blowing, the mirage ripples travel straight up and the target image is deflected upward. When a lateral wind is blowing from the right, say 3 o'clock, the ripples travel up and to the left, and the target image is deflected in that direction. With 6- and 12-o'clock winds the image is deflected straight up.

In aiming when the mirage is present, we aim at the deflected image of the target, and not at the target itself. If the mirage ripples are running straight up, showing a simple upward deflection of the image, we must decrease our elevation. If they are also drifting to the left, we must use right windage. If both mirage and lat-

TABLE OF LATERAL WIND ALLOWANCES.

Range	Correction in Points of Windage for Winds in Miles per Hour Blowing from											
	1, 5, 7, or 11 o'clock				2, 4, 8, or 10 o'clock				or 9 o'clock			
Yards	Wind	Points	Wind	Points	Wind	Points	Wind	Points	Wind	Points	Wind	Points
200	2	0	16	¼	2	0	16	½	2	0	16	½
	4	0	18	¼	4	0	18	½	4	¼	18	¾
	6	0	20	¼	6	¼	20	½	6	¼	20	¾
	8	¼	22	½	8	¼	22	½	8	¼	22	¾
	10	¼	24	½	10	¼	24	½	10	½	24	1
	12	¼	26	½	12	½	26	½	12	½	26	1
	14	¼	28	½	14	½	28	1	14	½	28	1
300	2	0	16	½	2	0	16	1	2	¼	16	1
	4	¼	18	½	4	¼	18	1	4	¼	18	1¼
	6	¼	20	½	6	¼	20	1	6	½	20	1¼
	8	¼	22	½	8	½	22	1¼	8	½	22	1½
	10	¼	24	½	10	½	24	1¼	10	½	24	1½
	12	½	26	½	12	½	26	1½	12	¾	26	1¾
	14	½	28	1	14	½	28	1½	14	1	28	1¾
500	2	¼	16	1	2	¼	16	1¾	2	¼	16	2
	4	¼	18	1	4	½	18	1¾	4	½	18	2¼
	6	¼	20	1¼	6	½	20	2	6	¾	20	2½
	8	½	22	1¼	8	½	22	2¼	8	1	22	2¾
	10	½	24	1½	10	1	24	2½	10	1¼	24	2¾
	12	½	26	1½	12	1¼	26	2¾	12	1½	26	3
	14	¾	28	1¾	14	1½	28	2¾	14	1¾	28	3¼
600	2	¼	16	1¼	2	¼	16	2	2	½	16	2½
	4	¼	18	1¼	4	½	18	2¼	4	½	18	2¾
	6	½	20	1½	6	½	20	2½	6	1	20	3
	8	½	22	1¾	8	1	22	2¾	8	1¼	22	3¼
	10	½	24	1¾	10	1¼	24	3	10	1½	24	3½
	12	1	26	2	12	1½	26	3¼	12	1¾	26	4
	14	1	28	2	14	1¾	28	3½	14	2	28	4¼
800	2	¼	16	1¾	2	¼	16	3	2	½	16	3½
	4	½	18	2	4	½	18	3¼	4	¾	18	4
	6	½	20	2¼	6	1	20	3½	6	1¼	20	4¼
	8	½	22	2¼	8	1½	22	4	8	1¾	22	4¾
	10	1	24	2½	10	1¾	24	4½	10	2¼	24	5¼
	12	1¼	26	2¾	12	2¼	26	4¾	12	2½	26	5½
	14	1½	28	3	14	2½	28	5	14	3	28	6
1000	2	¼	16	2¼	2	½	16	4	2	½	16	4½
	4	½	18	2½	4	1	18	4½	4	1¼	18	5¼
	6	¾	20	3	6	1½	20	5	6	1¾	20	5¾
	8	1¼	22	3¼	8	2	22	5½	8	2¼	22	6¼
	10	1½	24	3½	10	2½	24	6	10	2¾	24	7
	12	1¾	26	3¾	12	3	26	6¼	12	3½	26	7½
	14	2	28	4	14	3½	28	6¾	14	4	28	8

Courtesy of U. S. Cartridge Co. and Major E. Claude Goddard, N. G. P.

TABLE OF LONGITUDINAL WIND ALLOWANCES.

Wind Velocities		5 Miles		10 Miles		15 Miles		20 Miles		25 Miles		30 Miles	
Direction of Wind		6	12	6	12	6	12	6	12	6	12	6	12
Variation at Target		+ Inches	— Inches	+ Inches	— Inches	+ Inches	— Inches	+ Inches	— Inches	+ Inches	— Inches	+ Inches	— Inches
Range in Yards	100	.01	.01	.03	.02	.04	.05	.04	.05	.06	.06	.08	.07
	200	.06	.06	.12	.11	.18	.18	.20	.20	.31	.27	.4	.36
	300	.2	.2	.41	.40	.61	.60	.80	.80	1.03	1.	1.22	1.20
	400	.34	.34	.69	.68	1.05	1.02	1.4	1.3	1.7	1.68	2.1	2.
	500	.7	.7	1.4	1.3	2.1	2.07	2.8	2.7	3.53	3.44	4.2	4.1
	600	1.3	1.26	2.5	2.4	3.84	3.75	5.1	5.	6.39	6.23	7.7	7.5
	700	2.2	2.16	4.4	4.3	6.6	6.4	8.7	8.	11.14	10.61	13.4	12.7
	800	3.9	3.82	7.8	7.6	11.8	11.3	15.8	15.	20.1	18.7	24.4	21.6
	900	7.3	7.12	14.7	14.1	22.	21.	30.2	27.6	38.3	34.1	46.5	40.5
	1000	12.4	12.13	25.1	23.9	38.2	33.5	51.4	46.8	65.2	57.8	79.2	68.7

In practice disregard variations above heavy horizontal lines.

eral wind are very strong, the mirage may appear to have only lateral with no upward movement, in which case only windage correction will be needed. No rule can be given as to the amount of correction required. The amount of mirage running, its velocity, and the strength of the wind are the guides. On ranges in the northern part of the United States the displacement is seldom more than 4 feet at 100 yards, but in the Southwest, where the mirage may be very heavy, it frequently deflects the image as much as 12 feet. This displacement can only be measured by setting a transit on the target at dawn, when no mirage is running, and noting the displacement thereafter.

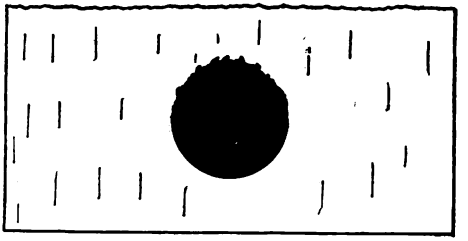
On some ranges mirage seems to occur very seldom, and when it is in evidence it seems to cause no displacement of the target image, but only blurs the outlines of the target and bull's-eye and causes them to "dance." In a case like this, one cannot hold his sights as near the bull's-eye, and also the bull's-eye appears larger. When the mirage is of this character, it will require an increase in elevation, instead of a decrease. It is rather difficult to tell whether a slight mirage has any displacing effect, and in such a case it is perhaps better to make no allowance for it

for the first shot, as the allowance will be small in any case.

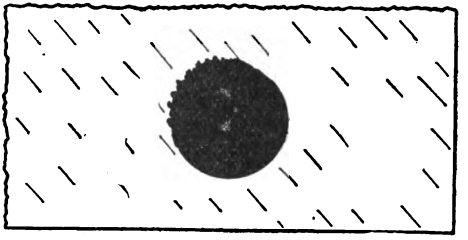
Mirage can be seen when the light is bright over all the range and when the first half of the range is bright and the target half is shadowed. It is greatest when the ground is wet, on sandy plains, or where the range is traversed by water-courses. On ranges of this character, mirage can be seen even on cloudy days and in cold weather. High winds will dispel it. The three diagrams will explain more plainly than words what to look for and the correction needed.

To judge the mirage correctly, a powerful telescope of long focus is needed. One of about 30 diameters power, with a 2-inch object-glass, is the best, and it can be conveniently mounted about 12 inches above the ground and alongside the riflemen. Field-glasses of low power and short or universal focus mislead, for they show the mirage near the firing-point, and not that near the target.

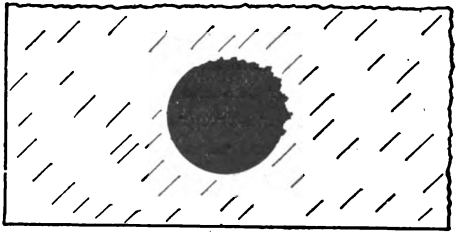
As we have seen in the previous chapter, mirage is a most trustworthy guide to the wind velocity and direction. The wind velocity may be determined by estimating the travel of the mirage ripples in miles per hour. Wind at 1 mile per hour equals 18 inches per second.



WIND FROM 6 OR 12 O'CLOCK, OR NO WIND
IMAGE DEFLECTED UPWARD



WIND FROM THE RIGHT
IMAGE DEFLECTED UP AND TO THE LEFT



WIND FROM THE LEFT
IMAGE DEFLECTED UP AND TO THE RIGHT

FIGURE 16.
Appearance of the Long-Range Targets in Mirage.

Light.

The amount of light present on the rifle range and the direction from which it comes affects the clearness with which the target may be seen, the marksman's eyes, and the manner in which he sees his sights. When the sun is behind the target and shining through it, the bull's-eye appears so gray that it almost blends with the white of the remainder of the target. A man with very strong eyes may still be able to aim at the bull's-eye, while others must be content with the calculated center of the target, and the scores suffer.

The effect of light on the seeing of the sights depends so much on the strength of the marksman's eyes and the pains he takes in seeing his sights exactly the same each time that no rule can be given. Light affects those who use the peep sight very much less than it does those who use the open. When using the peep sight, the great majority of men decrease their elevation for bright lights and sunny days and increase it for dark lights and cloudy days. The maximum correction will seldom be more than 2 minutes, measured by the micrometer. Do not confuse the corrections for light and those for mirage. If the sights are shaded by some object, use the same correction as for a dark day.

Strong light falling on the side of the front sights reflects a glimmer on that side, making the front sight appear thicker, and the sights are thus really aligned on the target a trifle to the opposite side; move your wind-gauge a trifle toward the light. Here the question of eyes comes in. Some men will have such strong eyes that they will see right through this glimmer, and for them no correction is needed.

The open sight can be seen correctly and accurately when the day is dark or both sights are shaded. If the light shines strongly on top of the front sight, the glimmer will cause the sight to appear higher than it really is, and in reality a fine sight will be taken; raise your elevation slightly. Here again strong eyes may see through the glimmer and no correction will be needed. With bright targets lower your elevation, and with dark targets raise your elevation.

These rules are by no means general. The effect of light on the seeing of the sights will have to be determined for each individual.

The following rules formulated by Major E. C. Goddard, of the National Guard of Pennsylvania, will be found applicable in the majority of cases:

Bright firing-point, bright target, B. B.
Bright firing-point, dark target, B. D.

Dark firing-point, dark target, D. D.
Dark firing-point, bright target, D. B.

As will be seen, the first letter refers to the light at the firing-point and the second to the light at the target.

When B.B. changes to D.B. lower your elevation.
" B.B. " " B.D. raise " "
" D.D. " " D.B. lower " "
" D.D. " " B.D. raise " "

If the sky is bright and becomes overcast, a lower elevation will be required, and *vice versa,* a raise will be required.

If on a dull day the sun should appear and light up the sights, but not the target, higher elevation is required.

If on a dull day the sun should appear and light up the target, but not the sights, a lower elevation is required.

A sudden overcast, placing the sights in shade, while the target remains lighted up, requires a lower elevation.

A sudden overcast, placing the target in shade, while the sights remain lighted up, requires a higher elevation.

When the sky is overcast, and the light is of a dull gray, and evenly diffused, the air over the whole range is more likely to be of a uniform temperature, and free from local winds. Such

weather is, therefore, the most favorable for accurate shooting.

Temperature.

The temperature has a decided effect on elevations. When the weather is warm or the gun very hot, the shots will fly higher, with increased velocity, and a lower elevation will be required. Cold air offers more resistance to the bullet than warm air, and a hot barrel expands and offers less resistance to the passage of the bullet through it than a cold barrel. Low temperatures call for increased elevation. The change, for instance, between a hot day in summer and a cold day in winter, is considerable.

In order to determine the change necessary in yards on the sight, the rule is: Multiply the number of degrees of change in temperature by the number of hundreds of yards, and divide the result by 10. This gives the number of yards of increase for fall of temperature, or decrease for rise of temperature, to which the change is equal.

A change of 7½ degrees of temperature is equal to 1 minute on the micrometer. Thus 7½ degrees rise in the thermometer will require a decrease in elevation of 1 minute on the micrometer, for it will cause the shot to strike 1

inch higher on the target for every 100 yards of range.

Take 70 degrees F. for normal in the United States, or 90 degrees in the tropics.

When the barrel becomes very hot from rapid firing on a hot day, the elevation must be decreased. In slow fire the rifle seldom heats up enough to one range to require a correction from this cause, unless the bore be very small or the bullets very large.

Barometer.

Changes in barometer cause changes in the density of the air, and hence make necessary a change in elevation, due to the varied resistance of the air to the flight of the bullet. If the barometer is high, the air is dense, offering greater resistance to the bullet; hence greater elevation is required. The change shown by an inch rise or fall in the barometer has practically the same effect as a 15° change in temperature. A fall in barometer has the same effect on elevation as a rise of the thermometer, and *vice versa*. For high barometer, higher elevation is required, and for low barometer, lower elevation. A fall of 1 inch in barometer will require 2 minutes decrease in elevation on the micrometer, and *vice versa*.

It is seldom indeed that the barometer at any given locality varies more than 1 inch. Determine the reading of the barometer in your locality, on a clear day when the weather is settled, and use this reading as "normal." The barometer, of course, changes greatly with altitude. Thus the change from Colorado to the sea-level will be large and the corresponding elevations required at the two places will be considerable. The National Match teams of Western States, when visiting Sea Girt, New Jersey, have usually found such a great difference that elevations have had to be determined anew.

At low barometer, at very high altitudes, the atmosphere is remarkably clear, and the air offers considerably less resistance to the bullet. Very much better shooting can, therefore, be done at high than at low altitudes.

It often happens that changes required by temperature are offset by change in barometer. Thus, at high altitudes we have a low barometer, but we usually have there also a low temperature, and as these work in opposite directions on the elevation, the resulting change in elevation required is very small.

Hygrometer.

The hygrometer is an instrument used to indicate the percentage of saturation in the air. It

consists of a chemically treated spiral chip, which, by its sensitiveness to moisture, actuates a hand on a dial. Much moisture tends to soften the fouling in the barrel, reducing the friction of the bullets in their passage and causing them to strike higher on the target; while in the absence of dampness the opposite condition will obtain. On a dry day the air offers more resistance to the passage of the bullet, and on a damp day the opposite occurs. Experience has shown that in humid weather, especially if also warm, it is wise to start with a somewhat lower elevation than normal for the first shot, followed perhaps by a very slight increase for the next one or two shots; while in very dry (even though still warmer) weather the elevation for the first shot will need to be higher, followed by a somewhat greater increase than in the first instance for the succeeding shot or two. Each 10 per cent of saturation is equal to about 20 inches in elevation at 1000 yards, or 2 inches for every 100 yards. Thus, if the hygrometer shows an increase of 10 per cent. lower your elevation 2 minutes, and the reverse for a decrease. Moisture in the bore may, however, produce opposite results in two rifles, one of which is .001 inch larger in bore than the other. All corrections given in this chapter were de-

termined for standard rifles which had a bore measurement of .308 inch.

It is not, perhaps, out of place here to speak of the bad habit of wetting the bullets in the mouth before inserting them in the chamber. This habit is a relic of the old .45-caliber black-powder days, and no matter how efficient it may have proved then, with modern ammunition it will cause the shots to fly high and wild. The cartridges should be inserted in the rifle as clean and dry as possible, or else should have a uniform coating of graphite.

Rain calls for that correction which in indicated by the hygrometer. There seems, however, to be little difference in the atmosphere five minutes before a rain and that after the rain starts; provided, of course, the temperature does not change. In practice it is safer to lower the elevation from 1 to 2 minutes when the rain begins. Use 40 per cent as normal on the hygrometer for a dry climate, and 60 to 70 per cent for a damp one.

Small pocket thermometers, having cases for their protection, can be obtained anywhere. It is not necessary to obtain an expensive one. A good barometer is expensive, and should be standardized and kept so. It is not absolutely necessary to have one in the kit. If one is at

hand so that it can be observed just before going on the range, it is usually sufficient. Hygrometers can be obtained from dealers in scientific instruments and are not expensive. They should be kept in a case so as to protect them from injury. The thermometer should be read in the shade.

Summary.

Temperature: High thermometer, low elevation.
Low thermometer, higher elevation.
7½ degrees, 1 minute change on micrometer.
Barometer: High barometer, higher elevation.
Low barometer, lower elevation.
½ inch, 1 minute change on micrometer.
Hygrometer: High hygrometer, lower elevation.
Low hygrometer, higher elevation.
5 per cent in humidity, 1 minute on micrometer.
Rain: Lower elevation 1 to 2 minutes on micrometer.

Example of Changes in Elevation and Windage Caused by a Combination of These Conditions.

RANGE, 1000 YARDS.

Normal elevation, 940 yards or 57 minutes. Peep sight.
Zero at 1000 yards, ½ point, right.

	Normal conditions for normal elevation	Actual conditions for first shot	Change in elevation called for on micrometer	Allowance of windage necessary
Ammunition	F. A. 9-27-07 2646 N.G.S.Q.	Same		
Light	B-B	D-D	+ 1	
Mirage	Light /	Light \		¼ R
Thermometer	70°	80°	— 1½	
Barometer	29.80	29.30	— 1	
Hygrometer	60%	70%	— 2	
Wind	9 o'clock	4 o'k 6 mi		1½ R
			— 3½	1¾ R
	Normal elevation and zero		57	½ R
	Sight adjustment indicated		53½	2¼ R

CHAPTER XI.

The Score-Book.

The score-book is an absolutely necessary adjunct to a rifleman's equipment. The science of rifle-shooting has increased so much during the last few years, and become such a complex science, that without some systematic means of following all the various conditions and recording them accurately one soon becomes hopelessly confused. Moreover, without a record of this kind our rifle practice teaches us nothing but holding, sighting, and pulling the trigger. One who does not keep a record is hopelessly handicapped when pitted against one who does.

The score-book is not, as its name implies, a record of the score made in points. It is intended as an exact record of the rifle, ammunition, and man under the exact weather conditions existing at the instant the shot is fired, with also a record of these weather conditions. Any score-book which does not contain all this data is useless from the expert's point of view. We record in our score-book first the ammunition used and

the exact weather conditions. We then make our calculations, set our sights, record their readings, and fire. Having fired, we record where we called our shot and the exact point where it hit the target. The official scorer at each firing-point takes care that the value of each shot is recorded. We may put this down or not, just as we like, but we must put down the other data, for it is of vital importance. For recording our scores we should use separate sheets for each range and kind of fire.

We will now take, for example, the case of a man firing at 600 yards and show how he keeps a record of his shooting. (Follow carefully on Figure 17.) The man, as he comes to the firing-point, places his ammunition near his right hand where it will not get in the dust or dirt. He adjusts his gun-sling to his arm, asumes the correct firing position in a comfortable spot where he can see the target clearly, and places his score-book open on the ground near his right hand. He has previously recorded in it the readings of the temperature, barometer, and hygrometer, and the kind, date, and velocity of the ammunition he is going to use. Finding these to be about the same as for his normal elevation, he decides to use that elevation and records it in the columns marked "Elevation," and on the

first line of the form, which is the line for the first sighting shot. It reads 650 yards, or 38 minutes. He now has to estimate the wind. The direction is " 4 o'clock," and he records this under the column marked "Direction." The flag flies out at just about an angle of 45 degrees, showing about a 12-mile wind. He records this by drawing in the column marked "Flag" two lines—one for the staff and one for the flag-lift. If there is an anemometer on the range, he can record its reading in the column marked "Force," and this will give him his exact windage. The use of an anemometer makes one become quite expert at judging the force of winds, but it should be used for that only, and not be depended upon entirely. He then examines the mirage through his field-glasses. This shows nothing different from the flags, and he records its direction by a little wavy line. He then consults the "Table of Lateral Wind Allowances," which should be in the front of the score-book, and finds that this wind calls for a correction of 1½ points right, and records this in the "Wind-gauge" column. He then notes that he has sunlight on both sights and target and records this "B. B." in the column for " Light." He then aims and fires his first sighting shot. As the rifle goes off he is conscious that his sights were ex-

actly and correctly aligned—that is, he "calls" his shot a bull's-eye, and so records it by placing a small dot in the middle of the small bull's-eye in the column marked "Call." He then watches the target until it is marked. The marker scores him a close "4" at 11 o'clock and he marks it on the target diagram by placing the letter "A" (for the first sighting shot) just where the shot was marked and drawing a little circle around it. He also marks a "4" in the "Val." column. This shot, according to its call, should have been a center bull's-eye, but it has struck the target about 12 inches too high. For the second sighting shot he therefore reduces the elevation 2 minutes, making the sight read 620 yards, or 36 minutes. The first shot has been very little off for wind, so he decides not to correct for that, and the other conditions remaining the same, he so indicates by placing small lines in their columns. The second sighting shot is also called a bull's-eye and is marked a "bull" well in toward the center, and so recorded, using the letter "B" on the target diagram. The next shot is fired with no change in conditions or sight-adjustment, and also naturally results in a bull's-eye. This being the first scoring shot, its location is shown on the target diagram by the figure 1. Just before firing the second scoring shot, the rifleman

notices that the flags are dropped down, showing less velocity of wind, and he therefore reduces his windage allowance to 1 point. When he fires he is conscious that his front sight, instead of being directly under the bull's-eye, was under its left edge; that is, he calls his shot a "4" at 9 o'clock, and he notes this in the column for "Call" by placing a little dot on the left of the small bull's-eye. Sure enough, when the shot is marked, it is a "4" at 9 o'clock.

For the third scoring shot the conditions remain the same, except that a cloud is passing in front of the sun and has cast a shadow over the entire range. For this it is safest to raise the elevation a trifle, and the rifleman decides to raise 1 minute, and so records it. This shot is marked near the edge of the bull's-eye at 2 o'clock. Now this shot was called a center bull's-eye, but yet the shot is not very far from the point of call, and the rifleman may easily have made that much of an error in calling the shot, or he may have pulled it over there when getting the trigger off, or there may have been a slight let-up in the wind. The point to be noted, however, in a case like this, is not to be too ready to change for a single shot a little bit off, when the conditions do not clearly indicate it. In the present case, however, it will pay to keep a close

watch for any change of wind, and the rifleman closely examines the flags and mirage before he fires the fourth shot, but no change is seen. This shot is also a bull's-eye, a little towards 2 o'clock. For the fifth shot there is quite a decided change. The sun has come out and illuminated all the range, and the wind has dropped down until it barely moves the flag and the mirage is going nearly straight up. The elevation is therefore reduced 1 minute, and the windage reduced to ¼ point. This shot is marked at 3:30 o'clock on the edge of the bull's-eye, and on looking through the glass to see the target marked immediately after the shot, it was noticed that the mirage was going absolutely straight up, showing no deflecting wind at all. The wavy line in the mirage column is therefore corrected.

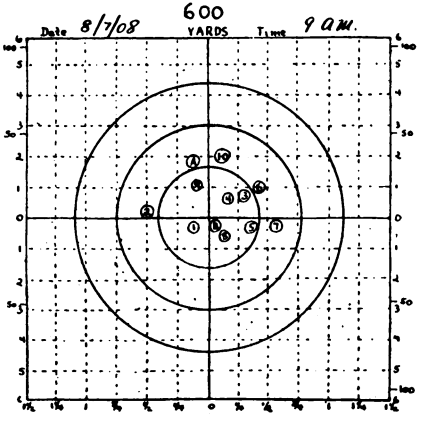
For the next shot a slight wind has sprung up from 10 o'clock; the rifleman estimates it at 2 miles, and allows a quarter of a point for it. This estimate, however, was evidently not enough, for he got a "4" at 2 o'clock. The wind continues to increase and for the next shot he allows 1 point. Also he fails on this shot to get a perfect pull-off, and calls his shot at 4 o'clock, and gets a "4" at 3 o'clock. This shot has hit where it should, so that, other conditions remaining the same, he makes no change for the

eighth shot and it results in a bull's-eye. The ninth shot also is fired under the same conditions and results in a "bull" at 11 o'clock. This shot has struck a little high, and ordinarily, in the latter part of a score at 600 yards or over, if we get a high shot, it is well to lower the elevation a trifle for the next; but in this case the elevation for all the succeeding shots has been so good that the rifleman decides not to change, and sure enough the tenth shot strikes high.

The sheet now shows the exact record of man, gun, ammunition, and conditions, and becomes a valuable aid when the rifleman again uses this rifle and ammunition at 600 yards. The actual score is 46 out of a possible 50.

It will be noticed that the target diagram is traversed by dotted horizontal and vertical lines. The vertical lines show the amount of correction on the target corresponding to a change of a quarter of a point on the wind-gauge. The horizontal lines show the amount of correction on the target corresponding to a change of 1 minute in elevation. The small numbers 50 and 100 at the side of the diagram show the amount of correction corresponding to a change in elevation of 50 or 100 yards.

The blanks for the other kinds of fire differ in principle so little from this one that they are easily understood.



BAROMETER	THERMOMETER	HYGROMETER	AMMUNITION	RIFLE No	ZERO
29.30	75°	60%	F.A. "1907" 263998	335828	0

WIND		Flag	LIGHT		MIR	NO	ELEVATION		WIND GAUGE		SCORE	
Direction	Force		Front Sight	Target			Yards	Min	Left	Right	Call	Val
4	12	∧	B	B	/	5	650	38	—	1½	◎	X
—	—	—	—	—	—	5	620	36	—	—	◎	X
—	—	—	—	—	—	1	—	—	—	—	◎	5
4	8	∧	—	—	—	2	—	—	—	1	◎	4
—	—	—	D	D	—	3	635	37	—	¼	◎	5
—	—	—	—	—	—	4	—	—	—	—	◎	5
—	2	∧	B	B	\	5	620	36	—	¼	◎	5
10	2	∧	—	—	∫	6	—	—	¼	—	◎	4
—	8	∧	—	—	—	7	—	—	1	—	◎	4
—	—	—	—	—	—	8	—	—	—	—	◎	5
—	—	—	—	—	—	9	—	—	—	—	◎	5
—	—	—	—	—	—	10	—	—	—	—	◎	4
										Total		46

FIGURE 17.—Mid-Range Score-Blank.
Courtesy of the United States Cartridge Co. and Major E. Claude Goddard.

The long-range blank shown in Figure 18 is of slightly different design from the mid-range blank shown in Figure 17. It covers two pages of the score-book, facing each other. For convenience in calculating the distance of the shot from the center of the bull's-eye, the target diagram is divided into dotted squares, the sides of each square representing 12 inches. The first column under "Call" is intended to be used as a check on the dots. "B" means bull's-eye, "6" a low call, "7" a 7-o'clock call, etc. A bull's-eye call is shown by placing the dot squarely in the middle of the square in the second column.

On the long-range target page, the diagram at the left of the target is the plotting diagram designed by Captain K. K. V. Casey, of the National Guard of Delaware. "This diagram is for plotting the shots to show the characteristics of the piece with reference to its vertical deviation. When the score is completed, take, as a base to work from, the elevation used for the greater number of shots. It will be noticed that every line is numbered at the top; the three sighting shot lines being marked by the letters 'SS.' Place each shot on the line of the plotting diagram corresponding to the number of the shot. Also place the shots on their proper horizontal line in the position they would have been in had

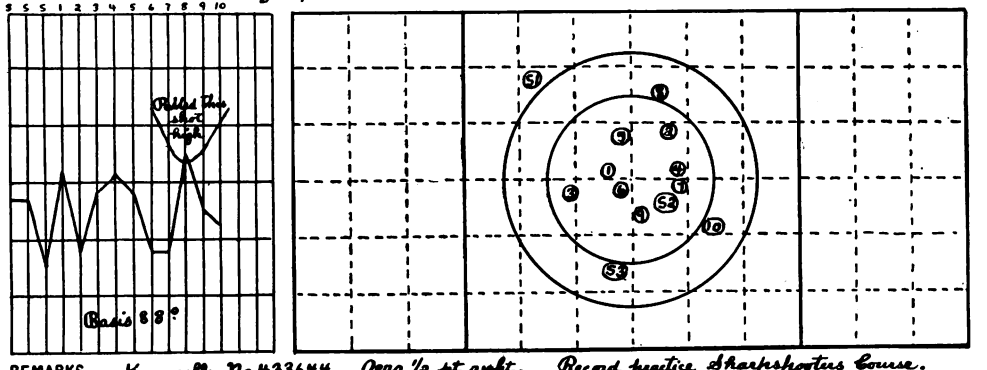


FIGURE 18.—The Long-Range Score-Blank.

THERMOMETER 80° HYGROMETER 76%

BAROMETER 31° WEATHER. Clear.

No	Val	Elevation		Wd Ga		Wind Direc	Flags	Mirage	Light. F P	Light. T	Call		No	Remarks
S S		97.5	90	2	L	9	∧ 8	/	Bt	Bt	B	·	S S	
S S		96.5	88	1¾	L	"	"	"	"	"	B	·	S S	
S S		"	"	"	"	"	"	"	"	"	6	·	S S	
1	5	"	"	"	"	"	"	"	"	"	B	·	1	
2	5	97.5	90	"	"	"	"	"	Ee	"	B	·	2	Cloud passed over firing point
3	5	96.5	88	"	"	"	"	"	Bt	"	7	·	3	
4	5	"	"	4⅕	L	"	∧ 16	/	"	"	B	·	4	Gusty
5	5	97.0	89	3⅕	L	10	"	/	"	"	B	·	5	Increased elevation a/c mirage
6	5	"	"	1¼	L	11	"	/	"	"	B	·	6	Left increase of elevation for these shots
7	5	"	"	½	R	12	"	⁞	"	"	B	·	7	a/c retardation of wind.
8	4	"	"	"	"	"	"	"	"	"	12	·	8	Pulled high
9	5	96.5	88	"	"	"	∧ 8	"	"	"	B	·	9	
10	4	"	"	"	"	"	∧ 4	"	"	"	4	·	10	
11													11	
12													12	
13													13	
14													14	
15													15	
48	Total Score.													

FIGURE 18.—The Long-Range Score-Blank.

they been fired with the same elevation as the majority of the shots. When all the shots have been plotted, connect each of these shot-marks with its successor by a straight line. This zig-zag line will give the rifleman an idea of the vertical deviation of the rifle and the manner in which it throws its shots. After several targets have been plotted, they will begin to bear a certain amount of resemblance to each other that will be apt to cause one to deliberate about changing the elevation where a shot has gone high or low." The score shown on this long-range score-sheet was fired with a Krag rifle.

Figure 19 shows a blank designed for recording a skirmish run that has proved very convenient. Enter the data for wind and weather, then calculate your elevations carefully for the different ranges, referring to your normal elevations and to the record of your scores in slow fire and using a trifle less elevation. Enter the zero of your rifle at each range, and then calculate your wind allowances. In the instance given in the figure, the increase of the zero at the longer ranges was such as to cause the wind allowance to have the same reading for each range. It is well to write the elevation and windage figures in lead pencil on your cuff or on the magazine gate of your rifle, so that you

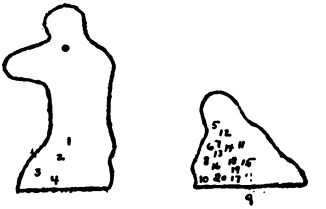
can refer to them during the run. It will be noticed that the figures for elevation are given only in yards. It is impossible, with the short time limit in skirmish, to use the micrometer to adjust the sights. On the slow-fire score blanks columns have been left for recording the elevation in yards, and this should always be done, in order to get the data for the skirmish elevations.

The consecutive shots are to be numbered on a separate diagram by an assistant. This assistant takes his place immediately back of the 600-yard firing-point. He is provided with a powerful telescope of at least 20 diameters, securely adjusted to bear on the target. As each shot is fired by the marksman the assistant, looking through the telescope, can note almost exactly where the shot struck, and numbers its location with the appropriate number on his diagram. After the marksman returns from the run, he copies the figures from his assistant's diagram on to his own score-blank. The locating of the shots in this manner shows the marksman exactly how much and in what manner his elevation and windage are at fault at any range. Recording runs in this manner, one can improve greatly at skirmish in a few trials. In the absence of an assistant, the only possible alternative is to visit the target and mark with a cross

RIFLE Krag 493644 SKIRMISH RUN DATE July 16 1905

Yards	Elev.	W.G.	Zero
600	485	1/4 R	3/4 R
500	395	"	3/4 R
400	300	"	3/4 R
350	265	"	1/2 R
300	210	"	1/3 R
200	150	"	1/3 R

Wind Direction 10 o'clock
Flags 1
Mirage /
Light Very bright.
Thermometer 69°
Barometer 30.6°
Hygrometer 85%



Notes Target No 10 - 11 a.m. Ammunition FA-7/22/04-1966
Expert rifleman's test. The wind evidently was not quite as much as calculated. Elevations O.K. 9th shot was not pulled low. Prone figure hard to see at 600 and 500 on account dark earth background.

Hits Kneeling. 4
Hits Prone 16 Score 96
Started firing at prone figure at 400 yards.

FIGURE 19—The Skirmish Score-Blank.

on the diagram where each shot struck, and then make elaborate notes of where you saw the dust kicked up by the bullet at each range.

Everything that could possibly be of value in the future should be noted on these score-cards. The more elaborately and carefully they are kept, the quicker will one get into the expert class. Improvement in marksmanship beyond a certain point is impossible without these records.

There are a great number of score-books on the market. Some are excellent, some good, and a great number worthless. The sample sheets shown here allow the recording of everything of value and are easily understood by a man of good education, but, of course, they would hardly be suited to a man who did not have that advantage. It might also be remarked that the latter's scores will never equal the former's until he has educated himself up to understand and appreciate these refinements. Our excellent rifle is a product of modern brains, and it certainly needs a certain degree of education or "brightness" to run it.

Score-books should be printed on amber or light blue paper, so as not to "dazzle" the eyes when used in sunlight. It is well to have a few loose leaves pinned to a board to use in the rain,

thus saving the book. All the tables shown in this book, and the changes necessary for different weather conditions, should be printed or copied in the front or rear of the book. One score-book is made with loose sheets filed in an aluminum cover, and is small enough for the blouse-pocket, which is an excellent idea.

CHAPTER XII.

Slow Fire.

In slow fire the shots must be fired in a time limit of 1 minute per shot, the time to be computed from the full appearance of the target, and after it has been marked, to the discharge of the rifle. Usually two men fire on one target, alternating shot for shot, so that one man has a much larger interval than 1 minute between his shots; but he has only 1 minute in which he can aim at the target. Calculations must be made quickly and entries in the score-book also hastened, so as not to go over this limit. If one will get his practice in these matters down to a system, there is plenty of time for everything. The rifleman should, if possible, make his calculations for the first shot and set his sights before he comes to the firing-point. Arriving there, he should deposit his cartridges, score-book, micrometer, lead pencil, and telescope, if he is using one, convenient to his right hand. He then assumes his position and thereafter remains quiet. He should not jump up or move around.

Above all, he should not hurry, but take his time and keep cool. He should obey without question all orders of the range officers, although he should not hesitate to appeal a decision which appears to him to be wrong or unfair. He should see that the scorer calls the value of each shot, when marked, in a loud voice, so that he can be plainly heard; then the rifleman can immediately check him if perchance he should give a wrong value for a shot. If shooting in pairs, the rifleman should pay no attention to the man alongside of him; in fact, the closer he attends to the details of his own shooting and the more he obliterates all other incidents the better will he succeed. These remarks pertain particularly to competitions.

Two sighting shots are required to precede the first scores at 500 and 600 yards. These must be taken and cannot be waived. Sometimes in matches sighting shots are also allowed at 200 and 300 yards. No warming or fouling shots are allowed, nor are they of very much value. The rifleman should not fire faster than he has to; otherwise his rifle will heat up and necessitate changes in elevation from this cause.

The rifleman should be very careful in pulling his trigger, and especially to avoid jerking it. In this respect he should follow carefully the

instructions in Chapter IV. It is best not to take up rapid fire or skirmish until one has become fairly proficient in slow fire, and also until the pulling of the trigger slowly and without jerk has become second nature. If one has any tendency to flinch, he should stick to slow fire until he has entirely overcome it.

If the first shot misses the target and the dust kicked up by the bullet shows the direction of the error, the correction for the second shot should be made as indicated heretofore. But if no dust or other indications of the error can be seen, the direction of the miss must be inferred from the conditions of the weather. If a strong side wind is blowing, the velocity of which it is hard to determine, the miss was more than likely to the right or left. If there is but little wind, if the day is either exceedingly dry or very damp, very bright or very dark, or if there is much mirage, the elevation assumed was probably incorrect.

In the first case, where the deviation is horizontal, the wind-gauge should be moved to the right (if it is thought that the shot went to the left) a distance equal to half of the target. If this does not result in a hit on the target, then the wind-gauge should be moved in the opposite direction a corresponding distance from the adjustment for the first shot. One or the other

of these changes will almost surely result in a shot on the target.

If the error which caused the miss appears to be a vertical one, the elevation for the second shot should be lowered a distance equal to half the target, and if this does not result in a hit, it should then be raised the same amount for the third shot. The rifleman should always change his sights, and never his point of aiming.

It is extremely important for one to get a good pull for and to be able to call correctly the first sighting shot. Great pains should therefore be taken with this shot. If this is done, one starts his score with correct elevation and windage, and the score will be good from the very start. Many scores are spoiled by uncertain sighting shots, and the beginning of the scoring shots with errors of sight-adjustment.

Before going to the firing-point, be sure you have attended to the following details:

The barrel of your rifle must be clean and dry.

The sights must be blackened.

You must examine the thermometer, barometer, and hygrometer, and note their readings in your score-book.

You must have on your person: 1, Ammunition with bullets graphited; 2, Score-book; 3. Pencil; 4. Field-Glasses or Telescope and Mountings; 5, Micrometer.

On arriving in rear of the firing-point, and before you take your place thereat, make all your calculations, except possibly those for wind, and set your sights, and make these entries in your score-book. Then you will not be hurried, and will be able to get your first sighting shot off correctly.

Before leaving the firing-point, one should always compare the score in his score-book with the record which the scorer has kept, in order to avoid any possible error.

CHAPTER XIII.

Rapid Fire.

In rapid fire at 200 and 300 yards, a time limit of 20 seconds is allowed in which to fire the five shots contained in the magazine. At 500 yards 30 seconds is allowed. This practice is conducted on Target "F," which is the black silhouette of a man kneeling, placed in the middle of a white target 6 feet square. In timed fire, which we will also consider in this chapter, the time limit is 30 seconds for the five shots, and the targets used are the regular slow-fire targets A and B.

In these classes of fire the marksman takes his place at the firing-point, having previously made his calculations and set his sights, and he then fills his magazine, loads one cartridge therefrom, and at command comes to the position of "ready." At a signal given from the firing-point (trumpet or telephone), the target appears, remains in sight for the exact time limit, and then disappears. The marksman fires his five shots, emptying the magazine and firing at will

from the instant any portion of the target appears until it has completely disappeared. Each unfired cartridge counts as a miss. The target is then run up again and the shots are marked on it in succession.

Usually a man will fire two scores of five shots each before leaving the firing-point. He should therefore watch the target very carefully while it is being marked, and if there appears to be any error in his sight-adjustment, he should correct it immediately before the second score.

It will be noticed in Target "F" that the greatest area of the black figure appears to be in the region of the hips. One should endeavor to have his shots strike in the middle of this region, as he then stands a larger chance for making a bull. The easiest way to do this is to aim so that the top of the front sight just touches the middle of the lower line of the figure, giving the rear sight additional elevation to carry the bullet well up into the broad hips.

At 200 yards it is best to use the open sight, as it is hard to catch the peep quickly enough.

In rapid fire it is far better to keep the rifle at the shoulder during the entire score than to remove it therefrom in order to work the bolt.

In the standing position, assume the half-arm extension, with or without the sling. Immedi-

ately after firing a shot, pull the rifle hard against the shoulder with the left hand while you work the bolt with the right.

In the sitting position at 300 yards, the right elbow and knee should never lose contact, for if they do, time will be consumed in regaining it. Make the knee follow the elbow and thus assist the right arm in working the bolt. Large comfortable holes for the feet are of great assistance here.

In firing prone at 500 yards, use the sling and assume the regular prone position. Having fired quickly, grasp the bolt handle with the right hand, turn it up and pull it back; at the same time pushing the piece over with the left hand so that the muzzle goes to the right and low. This latter movement makes it easier for the right hand to work the bolt quickly. As the right hand closes the bolt, the left hand brings the piece again into the position of *aim*. These movements should be thoroughly practiced in the position and aiming drills until at the instant the right hand regrasps the small of the stock with the finger on the trigger, the left hand will have brought the piece back so that it is correctly aimed at the target without further movement. This is entirely possible and easily learned when using the sling correctly in the

way previously illustrated. One should be sure to get this manipulation down to a fine point, as it is used not only in rapid fire, but also in skirmish.

In all rapid and timed fire and in skirmish the bolt should be worked as fast as possible, in order that as much time as possible may be devoted to holding, sighting, and pulling the trigger carefully. Have the bolt of the rifle well oiled, so that it will run easily. Be very careful to squeeze the triggger gradually and to avoid jerking it. Do not hurry. One has plenty of time. In instruction practice it will be an advantage to have someone call each 5 seconds of time, thus: "5," "10," "15," so that the marksman may know how the time is going. It is easy to fire all five shots in 10 seconds, but this cannot be done with accuracy. One should endeavor to consume about 18 seconds in firing his five shots in rapid fire, and 25 seconds in timed fire and rapid fire at 500 yards.

In rapid fire at 500 yards it is very important indeed to judge the wind correctly. If the judgment of the wind has been wrong, then one may bunch all his shots on one side of the figure and get "4s" or "3s" instead of "5s."

Very often an individiual will find that he does not shoot in the same place in rapid fire as he

did in slow fire. Many men will find that if they use the same elevation and windage in rapid fire that they would use in slow fire, their shots will group in the upper left-hand corner of the target, or in other directions. These individual equations must be determined and allowed for.

In firing in khaki uniform it will often be found that the butt of the rifle will slip on the shoulder during the firing of a score. If this is found to be the case, wetting the shoulder of the blouse with water will cause the butt-plate to adhere more firmly. If suspenders are worn with the web cartridge-belt, they should be let down off the right shoulder, as the butt of the rifle is very apt to slip on them.

On Target "F," hits to the left of the figure count 4, while those to the right only count 3. Therefore, in adjusting the sights for windage, it is well to calculate so as to place the shots a little to the left of the center of the figure, so as to lessen the chance of an accidental "3."

CHAPTER XIV.

Skirmish.

In skirmish fire the target is known as Target "G." It is composed of two iron frames, one, the shape of the silhouette of a man kneeling, and the other, of a man lying prone. These are made to stand upright on the ground by means of suitable legs. On them is laced a canvas covering, and the black paper silhouette is pasted on the canvas. The figures are set on the ground, usually on the glacis of the target butt. They are placed in line with 1 yard between the centers of the figures, the prone figure being on the right, facing the target. The value of hits, direct and ricochet, are: on the prone figure, 5; on the kneeling figure, 4. Hits on the black paper silhouette only count. When two or more targets are used on the same range, they are placed in line with an interval of not less than 5 yards between centers of groups.

While this is the regulation skirmish target, its form has caused considerable dissatisfaction. Shots striking the ground immediately in front

of the target often drive large rocks or lumps of dirt through the target, tearing such large holes in it that it cannot be counted and the marksman has to repeat his run. Also shots striking the iron frame are apt to tear the target badly. The conditions with this target are liable to be different on different ranges. On one range the targets may be set on hard gravel and they will be seen with great distinctness, and a shot striking two or three feet in front of the target will be almost sure to ricochet through; while on another range the targets may be placed on a soft, grassy glacis, where they are almost invisible and ricochets are impossible.

Many different targets have been devised to overcome these objections. At the last National Match (1908) the skirmish target consisted of the kneeling and prone figures printed on a white target 6 feet square, and this was displayed from the butt exactly as the regular mid-range target is displayed. The following instructions have been written with a view to their being adaptable to any form of target.

For the procedure in skirmish fire, one should consult Paragraph 141, *Small-Arms Firing Regulations* 1906.

Elevation and zero are everything in skirmishing. They must be known exactly, to an inch

if possible, at each range. Start work on the skirmish figures pasted on a 6x6-foot white target, and have every shot marked with a spotter, keeping an accurate record in your score-book. Start in at 200 yards and work back to 600 yards. Now, using the same elevations, start at 600 yards and work down to 200 yards, but at each range fire the prescribed number of shots within the time limit and see if they fall in the same place as in slow fire. If they do not, correct the elevation and zero to agree with your rapid-fire error. Lastly, have the regular skirmish target put up and make a regular run, except that between ranges have a marker come out from the pit and mark each bullet-hole with the number of that range in red pencil. This will give you complete and final data.

The best manner of aiming is to have the figure appear as though it were kneeling or lying on top of the front sight. At any rate, the aim should be taken at exactly the same spot at each range. At each range fire on the kneeling or prone figure just as you would in a regular run. On ranges where dust can be seen behind the figures, and the prone figure stands out distinctly against a light background, many men will fire all their shots at this figure.

Under these conditions at Fort Sheridan, dur-

ing the Army competitions in 1905, six possibles, scoring 100, were made. Where, however, the figures are up in the air and against the sky, as at Camp Perry, many find that they make their best average shooting at the kneeling figure at 600, 500, 400, and 350 yards, and at the prone figure at 300 and 200 yards.

On ranges where one can obtain ricochets with fair certainty, the elevations should be so adjusted as to have the center of the group fall at the mark R, Figure 20. Where, however, direct hits only will score, the shots should fall higher than this, at the point marked D. In firing on the kneeling figure at 600 yards, when there is no chance for ricochets, the shots should fall at the point 6. Elevations so adjusted have been found to give the greatest certainty of hits. In all your firing try to prevent your shots from going under the arm of the kneeling figure or over the back of the prone figure, for most of the misses occur in these locations.

Let me strongly advise you in all finding of elevations and in practice runs to use the Stevens-Pope micrometer sight elevator, which can be left on the rifle while firing. The micrometer is as great a factor toward high scores in skirmish as it is in slow fire. The British vernier will not answer for this purpose. I

thoroughly believe in the use of the peep sight at every range, and all data here given has been worked out for that sight.

When using the micrometer it will be found that a certain lowering of elevation is necessary between each range. This change seems to be constant with everyone, and does not differ with individuals. Presuming that one is firing at the prone figure entirely, this will be found to be as follows:

From	600	to	500	yards.....	lower	4.3	minutes.
"	500	"	400	"	"	4.	"
"	400	"	350	"	"	2.	"
"	350	"	300	"	"	1.7	"
"	300	"	200	"	"	3.	"

This table we will call the regular skirmish ratio. It was determined with ammunition manufactured at the Frankford Arsenal, with the 150-grain sharp-pointed bullet and giving an instrumental velocity, measured at 78 feet from the muzzle, of about 2640 feet.

Where one fires at the kneeling figure at the longer ranges a small change should be made, for one wants his shots to strike higher on the kneeling than on the prone figure. Thus if we shoot at the kneeling figure at 600, 500, and 400 yards, and at the prone at the shorter ranges, instead of having 2 minutes difference between

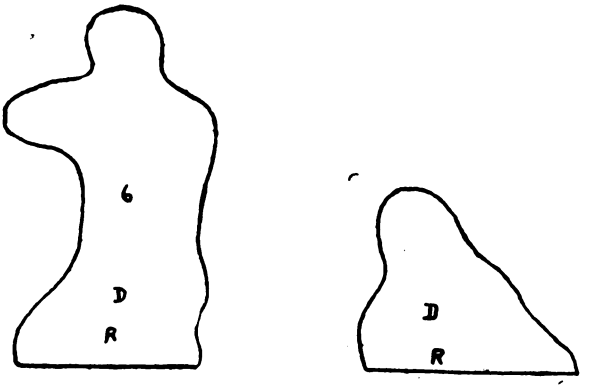


Figure 20.

400 and 350 yards, we make the difference 3 minutes, setting the elevations for the kneeling figure 1 minute higher. The altered ratio then becomes 4.3, 4, 3, 1.7, 3.

It is extremely difficult in the hurry and excitement of a skirmish run to adjust the sight to correct elevation necessary to have the bullets fall with certainty on the exact spot desired. It can hardly be done with the hands unless, happily, the correct elevations coincide with some distinct line or mark on the sight-leaf.

The Regulations do not allow a permanently affixed micrometer in record practice or in competitions. That is, the micrometer must not be attached to the rifle when the latter is fired. Therefore it is practically impossible to use the micrometer in skirmishing, except in practice runs, as it takes too much time to put it on the sight and take it off.

After one has correctly found his elevations with the micrometer, I would recommend his making a skirmish sight-adjuster for those elevations. This consists simply in a piece of sheet brass made in the form illutrated in Figure 21. It is made by the rifleman himself with the aid of a small vise and a flat file. The making takes about fifteen minutes. The height of each step is the distance from the wind-gauge scale to the

under side of the sighting-bar when the sight is correctly adjusted for the range. The firing should be done with great care, so that the adjuster will exactly set the sights at the elevations as determined by firing and recorded by the micrometer.

To use the adjuster the under side is placed in contact with the wind-gauge scale, the brass plate being on a line with the two zeros on the scale. The sighting-bar is then lowered on to the step, being careful to allow the next higher step above the range desired to pass to the left of the projection containing the battle-sight. The sighting-bar is pressed down hard on the adjuster, clamped fast, and the adjuster removed. With five minutes' practice this can be done instantaneously, and quite a little faster than setting by hand in the regular way, as there are no fine adjustments to be made by the eye.

Some riflemen will argue that this adjuster does not allow of those changes in elevation called for by weather conditions. It is, however, so simple that three can be made; one to adjust to 1 minute over normal elevation at all ranges, and one to 1 minute below. Practically, however, in skirmish firing, no alteration from the normal elevations should be made, except at 600 yards. Head or rear winds at short-

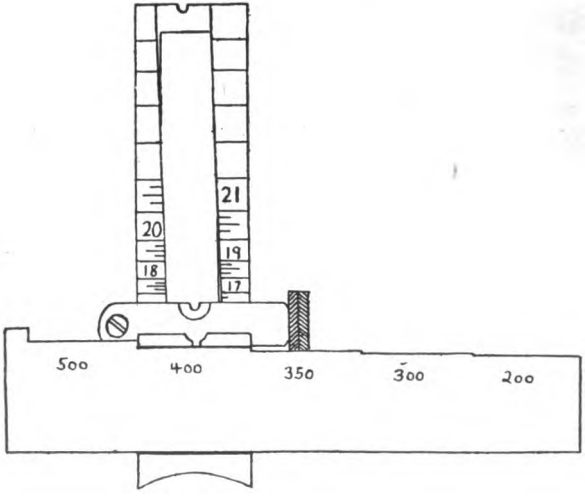


Figure 21.

er ranges than 600 yards make no appreciable difference in elevation. When one gets well into a skirmish run, the barrel becomes very hot, and the conditions of the gun are practically identical for every run.

Experience has proved conclusively that is is not safe to depart from the normal elevations at ranges, below 600 yards. Thus this adjuster, constructed for the normal elevations, can be absolutely relied upon. Of course, there will be considerable difference in the sort-range elevations between winter and summer, on account of the great difference in temperature. Also, the short-range elevations will differ in different localities according to the baromatic pressure.

Having made the adjuster, we are now ready for a regular skirmish run. Wipe your barrel free from oil, smoke the sights, and oil the bolt. Roll up the left sleeve of your undershirt so as to make a hump just below where the sling is to come on the arm. Put on your cartridge-belt and, having graphited your bullets, arrange the clips in the pockets of the belt where they can be easily gotten at with the right hand. Be sure you have your micrometer, skirmish adjuster, field-glasses, score-book, and pencil with you; then go to the range. Make your calculations as to elevation and windage for the 600-yard

range and set your sights with the micrometer. Also make your windage calculations for all the other ranges. Then write the data for elevation in yards and for windage at each range on a small piece of paper about 2 inches square and pin this to the left cuff of your blouse or shirt where it will be in plain view when you assume the firing position. This paper should have recorded on it, for instance, the following:

Skirmish Data.

Yards.	Elev.	W. G.
500	500	1 3-5
400	415	1 1-5
350	360	1
300	300	4-5
200	250	1-2

You will then have this paper to refer to in setting your sights at each range and will not have to trust to memory, which is very unsafe in the hurry of a skirmish run. The reason for putting on it the elevation in yards is that you may accidentally lose your skirmish adjuster in the grass and be unable to recover it in time.

For instance, if you estimate your windage at 600 yards to be 2 points, then follow on the 600-yard line to the 2-point column and read down, and you will have the correct windage for all the other ranges.

Then adjust the sling carefully to the left arm above the roll of the undershirt sleeve, and fasten it there by slipping down one of the keepers of the sling. The sling is to be kept adjusted during the entire run and never removed from the arm.

Now, if you have time, go to the 600-yard firing-point, lie down, sight on your target, note where your elbows come on the ground, and make small holes for them. This gives greater steadiness. Then return in rear of the line. At the command of the officer in charge of the skirmishers, load, filling the magazine with a full clip and closing the bolt, thus loading a cartridge into the chamber. Have the skirmish adjuster in the right hand. At the command, move forward promptly, and, arriving at the firing-point, lie down, elbows in the holes previously made, place the adjuster on the ground to the right of the piece and convenient to the right hand, and, holding the piece in the position of *load*, await the command for firing. At the command or trumpet-call (last note) "Commence firing!" unlock the piece, aim carefully, and try to get the best pull possible for the first shot. Having fired the first shot, immediately eject the fired shell and load the second cartridge. Fire the second shot as soon as your are sure you can get

a good pull. Eject this shell instantly, load, and lock the piece. Then let your hand fly to the skirmish-adjuster on the ground, and then to the rear sight. Set the rear sight for the 500-yard elevation with the adjuster, then change the wind-gauge to agree with the memorandum you have pinned to your left cuff. Retain the skirmish elevator in the right hand. Glance at the flags to see if there has been a change in the wind, and await the signal to rise and move forward. In proceeding from one range to the next, carry the rifle under the left arm, muzzle to the front, and the sling still adjusted. If necessary, tighten the sling on the arm as you move forward.

These movements are repeated at each range, firing, of course, the correct number of cartridges. Examine each firing-point with your eye as you approach it, and choose a level place to lie down, where no tufts of grass will interfere with your vision of the target. As you lie down, try to find a hole or depression in the sod for your right elbow to rest in. It is very important that the right elbow should not even feel as though it might possibly slip. An elbow badly placed makes the position very unsteady. In some soils the heel can be dug into the ground before lying down, thus making a hole.

On approching the 400-yard firing-point, take a clip of cartridges from the belt and lay it, with the skirmish adjuster, near the right hand, but where it will not get dirty or wet. When you come to 400 yards, you will have but one cartridge in your rifle. Having fired that, immediately and quickly load the clip which is lying conveniently to hand, and fire the other two shots. Practice this quick loading with clips of dummy cartridges—it will pay. Similarly, on approaching the 350- and 300-yard firing-points, you should take a clip from the belt and place it on the ground, as you will have to load it immediately after firing the last shot at these ranges.

In rapid fire at 300 and 200 yards be especially sure about getting a hole for that right elbow, and don't lift the elbows from the ground in working the bolt. As you grasp and pull back the bolt with the right hand, lower and move the left hand to the right without changing its grasp on the rifle. This assists the right hand in opening the bolt without removing the elbow from the ground. As you close the bolt, bring the left hand back to the firing position and the sights on the target. After a little practice in this, one can fire very accurately and very fast. By not changing the grip of the left hand on

the piece, or letting the elbows leave the ground we hasten the return of the rifle accurately to the target.

Indeed, experience seems to show that after an amount of this practice one can get to that state where he sights for the first shot only, and pumps the succeeding shots in as fast as possible, with a surety that they will all be hits. Perhaps the greatest factor in getting a good skirmish average is to surely get in every shot at 300 and 200 yards on the prone. One is thus sure of 50 points and everything he gets back of 300 yards.

Hits can surely be made at 300 and 200 yards in slow fire, and in order to assure them in the rapid fire, it helps greatly if one can work his bolt like lightning and have his sights come right back on the target, so that he has a little time to get a perfect sight and a good pull-off.

All these movements are of the greatest importance, so do not slur any of them. It is necessary to get them down so fine that they are done automatically and with great speed and precision. You must have all the time possible for aiming, pulling, setting the sights, and watching conditions, and your mind must be burdened with nothing else. You cannot expect to skirmish well until you have come to do everything

else without thinking and with great speed and accuracy. Lay off a skirmish range anywhere—it does not matter if the distances are not exact—and make a number of runs with dummy cartridges, until you know the whole procedure by heart.

On ranges where the skirmish figures are placed on or in front of a butt, the bullets will often throw up puffs of dust, giving an excellent indication as to the correctness of elevation and windage. If on such a range the first shot is seen to strike, say, 6 inches low and 6 inches to the left of the figure, then for the remaining shots at that range the piece should be held 6 inches higher and 6 inches to the right of the figure. The elevation and windage for the other ranges can be calculated anew on this data while one is proceeding from one range to another. Be sure, in your observations, to take into consideration the effect of the wind in displacing the puff of dust.

In order to get the greatest amount of profit from your practice, you should keep a score-sheet of every run, as shown in Chapter XI.

Here are a few things you would do well to remember:

Make all your calculations for 600 yards, and your windage calculations for all other ranges

in plenty of time before the run, so you will not be hurried at the last moment.

Keep your eyes open for any change in the wind during a run.

Be sure to get a good pull for every shot.

Immediately after the last shot at each range, set the sights for the next range.

Be sure to get a steady position at each halt. This is best insured by smooth, level ground, with a slight hole for the right elbow.

The 40-Shot Competition Run.

This run is prescribed for competitions in the Regular Army. Forty rounds of ammunition are issued to each competitor. The time limit remains the same as in the regular run. Five rounds must be fired at each halt, making it compulsory to fire at least 30 rounds. The other 10 rounds may be fired where desired. All loading must be with a full clip of five cartridges.

It will be seen that this run calls for extremely rapid work, and to succeed at it, one should do hours of practice with dummy cartridges at loading and firing quickly. No absolute rule can be prescribed as to where one should fire the extra cartridges or whether he should fire all of them. Of course, one should fire no more cartridges than he can be sure to get good aim and pulls for. The aim will necessarily be slow-

er at the longer ranges than it will at the shorter. At 500 yards one can hardly fire his five shots, load, and fire any more; but at 400 yards, if he works fast, he can perhaps fire five, load a clip, and fire one more in the 30 seconds. Then at 350 he can fire the four shots in the rifle, load, and fire three more; and at 300 yards he can fire the two shots in the rifle, load, and fire five more. It is difficult to fire more than five shots in the time limit of 20 seconds at 200 yards, but perhaps after firing five shots then, one may find time to load the rifle and fire another shot or so, making a total of 36 or 37 shots for the run. Many good shots distribute their cartridges in this manner, claiming it is about all they can pull well. Others will start firing the extra shots at 600 yards and will get in the whole 40 shots on the run. I think all, however, agree that it is unwise to so distribute the cartridges as to make it necessary to load a clip during the firing at 200 yards. If a man is firing 40 shots, he arranges it so that he comes to the 200-yard firing-point with his last five shots in his rifle.

During the latter part of a run, be sure not to touch your hands to the fixed base of the rear sight, as it will have become hot enough to burn them. In other respects the instructions given for the regular run will apply to this one also.

Sub-Skirmish.

Many men are unable to obtain any skirmish practice on account of the lack of a safe and suitable range. It is a poor locality, however, where a 200-yard range or a level spot of that length is not available. On such ground excellent skirmish practice can be had, by laying out a range the same as the regular skirmish range in every respect, except reduced to one-third the size, and then using a reduced load. A diagram of such a range is given in Figure 22.

In order to get the full length of run between ranges, plant stakes a little distance to the right or left of the range and half-way between the firing-points. Have them exactly 50 yards from the firing-points which they are between, except those between 400 and 350 yards, and between 350 and 300 yards, which should be only 25 yards. The marksman then in going from 600 to 500 yards (represented ranges) proceeds in quick time to the stake A, rounds it, and proceeds in double time to the 500-yard firing-point. The targets are made just one-third the size of the regular targets. They can be conveniently cut from heavy card-board or linoleum to give them the requisite stiffness without the iron frame, and then pasted over with black paper. In the absence of a better bullet-stop, a large

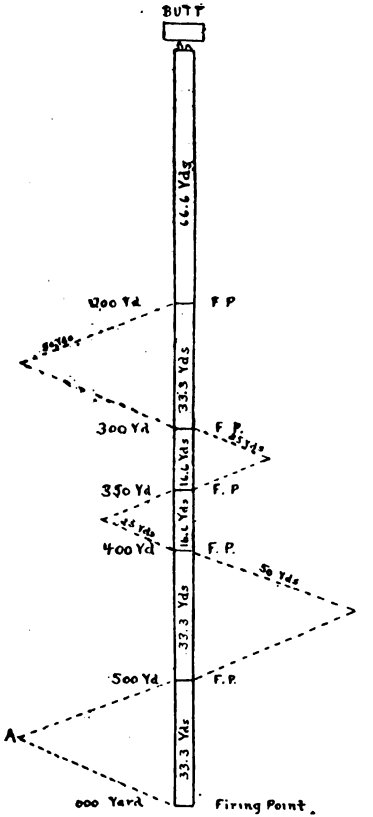


Figure 22.

packing-box preferably one for a piano, filled with sand and placed a foot behind the targets, will answer.

The service ammunition is both undesirable and unsafe for this use. Undesirable because the trajectory is so flat that no adjustment of sights is necessary during the run, which is a very desirable part of the practice; also because the load is expensive and causes much wear to the barrel. It is unsafe, because these sub-ranges from their very nature are extemporized without all safety precautions being taken in their location, and are usually in settled communities. Therefore a reduced load is usually used, and for this purpose I would recommend the load prescribed for Ideal Bullet No. 308280 in Chapter XVII. Of course, regular skirmish elevations will have to be found for this load. The sub-skirmish is an excellent makeshift for the National Guardsmen and civilians who do not have a regular range available.

CHAPTER XV.

Long Range.

"There are many good short-range men, who have simply not got the necessary brains nor education for first-rate long-range work; and there are very few officers capable of teaching it well, or who ever had half a chance to learn it." —*Tippins, in Modern Rifle-Shooting.*

The above quotation, from one of the greatest English experts, applies with equal force to our own service. It is not so much that long-range firing differs from short- or mid-range work, as that the laws which apply to short- and mid-range apply with equal or greater force to long range, and while one or two factors may be disregarded and still not spoil a mid-range score, yet the overlooking of a single thing will play havoc at 1000 yards. It will be seen that to apply all the principles and rules so far laid down in this work requires a thorough knowledge of them, a quick and active brain, good eyesight, and a good body; and also, it might be said, a

good education. These are, then, the essential qualities of a good long-range shot. Eliminate any one of these, and we will in all probability eliminate also the good scores.

Long ranges are classified as those between 600 and 1000 yards. Practically, however, there is little difference between the care necessary to make a creditable score at 600 yards and that necessary at 800 yards. The real difference comes when one retires to 1000 yards; therefore the following remarks will pertain more particularly to that range.

The rifle is the first consideration. The muzzle of the bore must be perfect to give the necessary accuracy. The bore must be smooth and free from rough places and rust, which would make it foul quickly with cupro-nickel. The barrel must be kept in perfect condition with the metal fouling solution, as directed in Chapter II.

The rifleman must do his own part perfectly. His hold must be steady and exactly the same at each shot. The same amount of tension should be placed on the gun-sling for each shot, and the elbows should lie in the same holes. The aim should be as correct as the eyes can see to make it. Canting or leaning of the sights must be carefully guarded against, as a hardly visible cant will carry one from the bull's-eye

into the "two space" on the target. And lastly, and most important, the pull must be perfect for every shot. The least little unsteadiness or jerk in the trigger-pull will cause a miss almost every time.

Every refinement must be used. The micrometer, telescope, and score-book are especially necessary. One may get an occasional good score without these aids, but his average work will be very poor indeed. By referring to the table on page 86, it will be seen that when using service ammunition and not using the micrometer the radius of the shot group will be about 35.17 inches. Of course, all the shots will not fly as wild as this, but every little while one will, and this one often is a miss, or else it causes one to think his sighting is wrong and plays the mischief with the score generally. Individuals and organizations shooting at long range without the micrometer will find that scores of 25 to 30 out of a possible 50 is about the best they are able to average. If, however, the micrometer is used, we eliminate the error in sight-adjustment and the radius of the shot group is reduced to about 18.9 inches. The average scores of good shots at 1000 yards under these conditions will be found to run from

about 35 to 42 out of a possible 50. Service ammunition made in lots of millions of rounds cannot, of course, have the special attention given to it during manufacture which makes special match ammunition so accurate. Service ammunition gives a mean vertical deviation at 1000 yards of about 8.9 inches, and the special match ammunition used by the American Bisley Team in 1908 gave a deviation of only 5.29 inches. This difference is enough to cause the best shots of the country using the latter ammunition to average 47 to 48 out of a possible 50 at 1000 yards, and with this ammunition perfect scores of 50 at 1000 yards have become very common. Therefore, at long range, to get good results, you must use a micrometer and the most perfect ammunition you can obtain.

A good telescope or powerful field-glass is also essential. Small changes in mirage drift must be watched for, quickly determined, and allowance made for them. This is especially necessary in fish-tail* winds.

*Fish-tail winds are those coming from the general direction of 6 or 12 o'clock, but which are constantly changing from 5 to 7 o'clock, or from 11 to 1 o'clock. The flag flutters from one side to the other continuously, and it only through the glass that one can gain a true estimate.

The score-book is very necessary at long range, in order that one may keep accurate records of elevations and weather conditions. These change so often, and the change amounts to so much at long range, that any attempt to keep these in the head soon results in confusion and drives everyone to the score-book.

You must have a thermometer, barometer, and hygrometer, and must use them. It is not necessary to bring them to the firing-point, but they should be read shortly before firing. A man may use an elevation of 1025 yards at the 1000-yard range one day, and the next day his correct elevation may be only 900 yards. If he has no instruments and does not know how to use them, it may take him from five to fifteen shots before he gets a hit on the target. Many men's qualifications as sharpshooters and expert riflemen are ruined from this cause.

A score previously fired at 800 yards does not always give a true indication of what the elevation will be at 1000 yards. Often one will fire and make an excellent score at 800 yards with his normal elevation, and on immediately going back to 1000 yards he may find that at that range he has to use 4 or 5 minutes of elevation above or below normal.

It occasionally happens that elevations worked

out according to all the rules are not correct. It is here that the experience of the old and seasoned long-range shot comes in. He seems to know by instinct which way to move to get a hit. About the best way to become proficient at long range is to get such a man for a coach.

In some localities scores at long range will be found to average quite high despite the absence of all refinements. This will be found to be the case where weather conditions vary but little during the shooting season. Thus, in certain parts of the Philippine Islands and in California, and at certain seasons of the year and time of day, the thermometer, barometer, and hygrometer will be found to have almost the same readings day after day. Here the inexperienced shots are able to do very good work at long range. They find the correct elevation, and as long as they keep their rifles clean, and use the same ammunition, they can stick to that elevation during their whole season's practice. On the majority of ranges in our country, however, during the shooting season, we are liable to have changes in temperature of 300 degrees, changes in barometer of ¾ of an inch, and changes in hygrometer of 40 per cent; and these may make differences in elevation at 1000 yards of 150 yards, or 10 to 15 minutes.

"Unaccountables" are shots which either miss the target or else hit it in a quite different spot from what was expected, and their deviation from the rest of the shot group cannot be accounted for. A true "unaccountable" is usually due to a faulty cartridge, but one has to be a very good shot indeed before he can truly blame a bad shot on the ammunition. Very often unaccountably bad shots are more liable to be small errors in pull-off, small changes in mirage, wind, or light, etc., which have escaped the rifleman's notice. With ammunition giving a large vertical deviation "unaccountables" are more liable to occur than with the more recent accurate loads. One may, for instance, aim a little high without noticing it, and then pull off a little high, and the shot may be one of those striking at the top of the shot group, in which case the shot may go over the top of the target, and lead one to think he has had an "unaccountable" shot when such is really not the case. With the recent great improvement in ammunition and the almost universal use of the micrometer, the word "unaccountable" has almost disappeared from the vocabulary of the really expert shot.

It is of little use attempting to get accurate results at long range when the targets are marked with the big old-fashioned marking disk.

One must know exactly where his shot hits the target. The alternative method of marking, with shot marks or "spotters,"* as prescribed in the latter part of Paragraph 103, *Small-Arms Firing Regulations* 1906, should be used exclusively.

To sum up, the following precautions should always be used in long-range firing:

1. *Keep your barrel in perfect condition.*

2. *Use a micrometer and the best ammunition you can get.*

3. *Read the thermometer, barometer, and hygrometer before starting your score, and figure out your elevation.*

4. *Watch the flags and mirage closely before each shot.*

5. *Remember that a perfect pull-off only will hit the target.*

*Spotters are small .30-caliber pegs or nails with a round head of card-board or tin. The spotter is inserted in the bullet-hole of the last shot fired and the card-board head is seen by the rifleman when the target is raised after being marked. Black card-board is used to mark shots which hit in the white of the target, and white card-board for the bull's-eyes. The card-board should be about 6 inches in diameter for long range and 3 inches for mid range. Field-glasses are needed to see them. This system of marking is used exclusively in the National Matches, and at Camp Perry and Sea Girt.

CHAPTER XVI.

Service Ammunition.

It is just as necessary to have accurate ammunition as it is to have an accurate rifle, and a knowledge of what constitutes a good ammunition is needed by every rifleman. In order to understand the subject thoroughly, it will be necessary to glance for a moment at the history of modern high-power ammunition development. Prior to the year 1900, the cartridge for the Krag rifle was loaded with Du Pont and Peyton Smokeless powders, and the bullet had a cupro-nickel jacket having one canelure, into which the shell was crimped. This ammunition was very defective—in fact, it would hardly stay on the target at 600 yards; and as a consequence fine shooting with the Krag up to this time was an unknown accomplishment. The bullet was badly balanced and in diameter measured a scant .307 inch, while the majority of barrels then in the hands of riflemen were bored extremely large, recording on the micrometer all the way from .308 to .313 inch. The consequence was that gas-cutting occurred—that is to say, the ex-

tremely hot gases rushed past between the bullet and the barrel and, cutting like a diamond-pointed tool, deformed both bullet and barrel and destroyed accuracy. The two mentioned kinds of powder, the only kinds produced at that time, were also deficient, giving a great amount of residue and many unburnt grains of powder. This fouling was flattened down into the grooves of the barrel by the passage of the succeeding bullets and caused variations in the velocity with the consequent increase in the vertical dispersion of shots.

Up to this time (1909) gas-cutting was almost an unknown factor in rifle ballistics. It did not figure in the ammunition for the .45-caliber Springfield rifle, because with black powder and lead bullets the explosion of the powder struck the bullet a severe blow, upsetting or expanding it immediately to completely fill the barrel to the bottom of the grooves. With smokeless powder and jacketed bullets there is scarcely any upset, and if the bullet in its original diameter does not fit the barrel completely to the bottom of the grooves, gas-cutting is sure to occur.

In the latter part of 1900 the Frankford Arsenal started the issue of ammunition loaded with Laflin & Rand W. A. powder and the "3-groove lubricated" bullet. This ammunition

was so much better than the old that target practice started to improve immediately. The W. A. powder was found to be practically perfect, and to this day continues to be the standard and best powder for our military rifles. The "3-groove lubricated" bullet was very much better balanced than the old bullet having three canelures which contained lubricant. The bullet, however, still measured .307 inch and gas-cutting continued to occur. This ammunition behaved very well up to 900 yards, but beyond that distance many of the bullets lost their gyrostatic stability and tumbled or key-holed, making the ammunition very unsatisfactory for 1000-yard work. The lubricant in the grooves of this bullet has since proved to be unnecessary. There exists a need for lubrication of high-power ammunition, but no lubricant has been found up to the present time which will fulfill the requirements. Owing to the high temperature developed by the smokeless powder, the ordinary lubricant undergoes chemical disorganization—is split up into its constituent elements, carbon and hydrogen. The hydrogen, being a gas, escapes, leaving the carbon behind; and the carbon, far from being a lubricant, only adds to the fouling of the gun.

In the summer of 1902, on the eve of an international rifle match, the Union Metallic Cart-

ridge Company, aided by their expert, Mr. W. M. Thomas, produced the first really satisfactory bullet that had appeared. This is known as the "Thomas" bullet. It is perfectly smooth, with no canelures, and, owing to the fact that the great majority of barrels measured over .308 inch, the new bullet was given a diameter of .3085 inch and the base was made perfectly straight and square. This brings us to the two great desideratums of modern rifle bullets. The bullet should have a diameter a trifle greater than the diameter of the bore of the barrel to prevent gas-cutting and to prolong the life of the barrel. The base of the bullet should be perfectly straight and square, and the bullet should maintain its maximum diameter right down to the base. If the bullet is made in this manner, the instant that the base of the bullet leaves the muzzle of the barrel the gas will escape equally all around and perfect delivery will occur. This is a great element in the accuracy of a bullet. If the base is in the least rounded, the gas is very apt to escape unequally at the instant of departure, and the gas first escaping will strike the base and side of the bullet, tipping it and giving it an unsteady flight.

Shortly after the appearance of the Thomas bullet, the Frankford Arsenal started to produce

its new smooth bullet, which was very much the same, except that it measured only .308 inch at its largest diameter, which was about ⅛ of an inch above the base. After that the Winchester Repeating Arms Company produced its Hudson-Winchester bullet and the Peters Cartridge Company its special bullet, so that to-day all the ammunition manufactured in this country for our military rifles is excellent and performs in a satisfactory manner.

When the Government first started to produce ammunition for the Model 1903 rifle, they used the new smooth bullet exactly as used in the Krag cartridge. With this bullet it was found that the increase of 300 feet per second in the velocity caused the jackets of about two bullets in every 100 to split, giving unaccountable misses. Therefore, in the spring of 1905, the jackets of the bullets were increased in thickness from .016 inch to .020 inch and the maximum diameter of the bullet increased from .308 to .3085 inch.

In the mean time the German Government had been making experiments with and had adopted a bullet having a very sharp, long point and weighing only 154 grains. This bullet was known as the Spitzer, and was calculated to be influenced or retarded by the resistance of the

air very much less than the old form of bullet. The bullet was given the then extreme velocity of 2700 feet per second, and the trajectory was greatly flattened at all ranges, giving a danger space for infantry against infantry of 700 yards.

The tactical advantages of this bullet were such that our Ordnance Department took the matter up at once. Contrary to expectations, it was found that the new bullet was very accurate and moreover that it was deflected by the wind only about half as much as a bullet of the old form of the same weight. Our old and reliable W. A. powder was found, however, to erode the barrel so much with these large charges as to be out of the question. The E. I. Du Pont de Nemours Powder Company, however, quickly developed two very satisfactory powders, the Pyrocellulose and the Du Pont Military Powder, the latter being known in the service as N. G. S. Q. powder.

The adaptation of this bullet to the Model 1903 rifle necessitated making the neck of the shell shorter and rechambering the rifle. These changes were made to all arms and the new rifles and ammunition were issued to both the Regular Army and National Guard during the winter of 1907-1908.

The more important data for this new cartridge, which is at present the standard ammunition for the Model 1903 rifle, are as follows:

Weight of bullet, 150 grains.

Diameter of bullet at base, .3085 inch max. —.3081 inch min.

Length of bullet, 1.095 inch max.—1.065 inch min.

Muzzle velocity, 2700 feet per second.

Instrumental velocity at 78 feet, 2640 feet per second.

Chamber pressure, 50,000 pounds.

These cartridges are packed in clips of five each. Sixty cartridges, in twenty clips, are packed in a bandoleer of olive drab cloth, containing six pockets, each one holding two clips. Twelve hundred cartridges, in twenty bandoleers, are packed in a sealed zinc case enclosed in a wooden box 34.5 inches by 9.5 inches by 8.27 inches, which weighs when filled about 99 pounds. The date of loading of the contained cartridges is stamped on each end of the wooden box.

There has been considerable discussion as to which of the two powders used in this cartridge are the best. The Pyrocellulose powder gives much less erosion than the Du Pont 1908 Military, but it has been claimed that the residue of Pyrocellulose is very sticky, and that it accum-

ulates in the barrel, causing the shots to drop lower and lower on the target, until finally a shot comes along which seems to take out with it much of the fouling and the following shot goes much higher. This fault, however, is not very well established, and the Ordnance Department have been unable to discover it. The shooting qualities of Pyrocellulose are greatly affected by the varying degrees of moisture in the air at the time of loading, so that cartridges loaded on one day are apt to shoot very differently from those loaded on another day. In shooting ammunition loaded with this powder, it is well to endeavor to get sufficient of one date of loading to carry one through the whole season's shooting.

It is claimed for the Du Pont 1908 Military Powder that it is free from these defects, but it undoubtedly erodes the bore more than does the Pyrocellulose. As a matter of fact, there are very few men indeed in the country who can shoot well enough to discover any difference between the two.

Pyrocellulose powder is a variety of nitrocellulose colloided or gelatinized by means of ether and alcohol, which afterwards evaporate; the colloid being formed into granules of the proper dimension for the gun in which it is to be shot. It has been used for several years in large guns

in our Navy. Its great advantage is due to the low temperature of its combustion. Pyrocellulose powder is more expensive to manufacture than the Du Pont 1908 Military Powder, which is practically the old W. A. formula modified so as to lower the temperature of combustion. With the latter powder the accurate life of a barrel measuring .308 inches for accurate long-range work is a little over 4500 rounds, provided it is properly cared for. With Pyrocellulose the life is about one-third longer than this. The normal charge of Pyrocellulose powder weighs from 48 to 50 grains.

In June, 1908, the National Rifle Association conducted a series of ammunition tests to determine the best ammunition for use by the American team in the International Olympic Rifle Matches in England in July of that year. These tests proved conclusively that the ammunition manufactured by the United States Cartridge Company was the best at that time. The bullet for this cartridge had the same point as the Government 150-grain bullet, but it was lengthened so as to weigh 180 grains. Enough Du Pont 1908 Military Powder was used to make the cartridge shoot with the same sight elevations as the Government standard ammunition. In the tests this ammunition showed a mean

vertical deviation of all record shots as follows:

Range	Slow fire 17 shots each.		
200 yards	.74 inches	1.21 inches	——
600 yards	2.81 inches	———	——
1000 yards	5.63 inches	5.17 inches	5.06 ins.
	Rapid fire 10 shots each.		
200 yards	.97 inches	1.05 inches	

Making a grand aggregate mean vertical deviation of all record shots fired of 2.83 inches.

This ammunition should really not be classified as Service Ammunition, but rather as Special Match Ammunition; as, although it fulfills all the requirements of a good service ammunition, yet in time of war the rush of manufacture would make the little precautions taken in its manufacture impossible, and its accuracy would not be maintained so high.

One of the principal factors in the accuracy of a cartridge is the uniformity of the powder. It was found that a difference of 1 grain in the weight of powder in the Krag cartridge would make a difference in point of impact at 1000 yards of about 20 inches. It is probable that with the present cartridge the difference would be much less than this, but it would still be a big factor in the vertical deviation of the ammuni-

tion. Our modern powders cannot be measured with great accuracy, for the grains are of such shape that they pile up differently in the measure, sometimes forming small voids in the mass. The only way to get absolute uniformity in the powder charge is to weigh each charge separately, and the impression seems to exist among riflemen that the private ammunition companies resort to this in preparing ammunition for important competitions and for certain classes of customers.

In considering the improvements in bullets and powder we must not forget the primers. Formerly the primers were of the mercurial variety, but it was found that the mercury combined with the zinc in the shell metal, causing amalgamation and making the fired shells so brittle that they could not be reloaded. Since 1900 all Government ammunition has been loaded with a non-mercurial primer, known as the H 48, and the shells no longer become brittle and can be reloaded many times.

CHAPTER XVII.

Mid- and Short-Range Ammunition.

Service ammunition is very expensive and it quickly wears out the barrel of the rifle. Moreover it is unsafe to use it, except on a range especially designed or located for its use. There must be a large hill or mountain, large lake or ocean in rear of the range for a bullet-stop, for the maximum range is 5465 yards. These features often make it desirable to use another kind of ammunition.

Mid-range ammunition may be defined as ammunition accurate to 600 yards, which has less velocity and erosion, and which costs less to produce or reload, than service ammunition.

Short-range ammunition is accurate at 200 yards, less powerful, and cheaper than mid-range ammunition, and should cause no barrel erosion at all. Under this head may also be included gallery ammunition, which is accurate at ranges varying from 25 yards to 200 yards, according to the requirements.

These classes of ammunition are not on the market. They are loaded by individuals, clubs, and organizations of the National Guard, accord-

ing to their requirements and ideas. In order to understand correctly what is to follow, one should procure a copy of the *Ideal Handbook* from the Ideal Manufacturing Company, New Haven, Conn. It will be sent on request if four cents in stamps is enclosed. The little work is the authority in America on reloading ammunition, and is also partly the catalogue of the Ideal Manufacturing Company, who make reloading tools.

The following general rules apply in reloading ammunition:

Only shells manufactured at the Frankford Arsenal should be used, and preferably those that have been once fired in the rifle the reloaded ammunition is to be used in. If shells are to be kept loaded only a month or two, they need not be cleaned inside; otherwise they should be cleaned with acid, according to the formula given in the Appendix.

In priming shells, use the Government H 48 primer, Union Metallic Cartridge Company No. 9, or the United States Cartridge Company No. 2½. These are non-mercuric and do not injure the shells.

In measuring powder, use the Ideal Universal Powder Measures and set the scale according to the tables in the *Ideal Handbook*. There is lit-

tle advantage gained in weighing the powder charges unless the cartridges are intended for long-range work, in which case it is a necessity. Remember, smokeless powders do not weigh the same as black; also that different kinds differ in weight. The charges given here should not be exceeded, as a larger charge will either be dangerous or inaccurate.

If lead alloy bullets are used, they should have a diameter of .311 inch. Smaller bullets than this will be inaccurate. Moulding bullets is not recommended for the average man, as it takes considerable skill to produce a perfect bullet, and it is very little cheaper than buying them already moulded, lubricated, and sized from the Ideal Manufacturing Company.

Before starting to load the shells, their muzzles must be resized in a muzzle resizer and then expanded in a shell-expanding chamber, to just the size for the bullet intended to be used. Bullets should be tight enough in the shell after seating to prevent their receding on the powder with ordinary pressure. Crimping, however, destroys accuracy.

Ordinary alloy bullets cannot be used at velocities over about 1450 feet, as the large powder charge for high velocities generates so much heat that the base of the bullet is melted. If

higher velocities are desired, a copper base or gas check must be added to the bullet, as in bullet No. 308334. Alloy bullets cause less wear to the barrel than jacketed bullets. They are also much cheaper, and they give a slightly higher velocity with the same charge of powder.

If jacketed bullets are used, only those having cupro-nickel jackets should be purchased. Many inferior bullets, jacketed with copper and tin-plated, are on the market. These can easily be detected by polishing with brass polish.

Ideal Bullet Metal, procurable from the Ideal Manufacturing Company, is composed of 80 parts lead, 10 parts tin, 7 parts antimony, and 3 parts copper by weight. It is the most satisfactory alloy, as it is tough enough to stand the 10-inch twist of the rifling, and has a higher melting-point than a plain lead and tin alloy.

The accuracy of reloaded cartridges depends entirely upon the care taken, and the skill shown in loading. Properly loaded, this reloaded ammunition is far superior to the output of the machines.

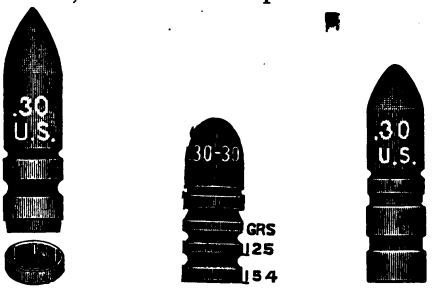
For mid-range work, a very satisfactory load is obtained by using the regular 150 grain Government jacketed bullet with a powder charge 31 grains weight of Laflin & Rand "Lightning" powder. This is a very fine shooting

cartridge, and comparatively cheap and very easy to reload. At 500 yards it will require an elevation of about 775 yards on the sight.

Another excellent mid-range load consists of Ideal bullet No. 308334, with copper gas check on the base and a powder charge of 25 grains weight of Lightning powder. The bullet should be made of Ideal alloy, lubricated and sized to .311 inch. Bullets can be purchased lubricated and sized with gas check affixed from the Ideal Company, or they can be moulded by the rifleman himself in moulds procured from the same firm. This load gives almost no barrel erosion at all and is cheaper than the foregoing load. It is, however, not quite so accurate in high winds as the other. This load is used extensively in the National Guard and for the school-boys shooting in the public schools.

For short-range work (200 and 300 yards) and sub-skirmish (see Chapter XIV.), I would recommend Ideal bullet No. 308280, cast of Ideal alloy and sized to .311 inch. The powder charge should be 15 grains weight of Du Pont Marksman or New Schuetzen powders. A larger charge of these powders should not be used behind a bullet with unprotected base. This load gives no barrel erosion at all and is very cheap, and quite accurate. The New Schuetzen powder is fine and cheaper than Marksman.

For gallery work, I have found the most satisfactory load to be Ideal bullet No. 308241, cast of half Ideal alloy and half pure lead and sized to .311 inch, with a powder charge of 1½ grains weight of Marksman or New Schuetzen powders. The bullets can be purchased from the Ideal Company for $4.50 per thousand. This load is quite accurate, even at 200 yards. I have fired many thousand rounds of it with perfect satisfaction, even in the tropics.



No. 308334. No. 308241. No. 308280.

FIGURE 23—Ideal Mid- and Short-Range Bullets.*

*General Drain, President of the National Rifle Association and editor of *Arms and the Man*, reports that the first prize, in the late Ideal Short-Range Military Rifle Match, amounting to $80, was won by Charles B. Chisholm, of Company "C," 5th Infantry, O. N. G., Cleveland, O. He used bullet No. 308241; distance shot, 50 yards, indoor; bull's-eye, 2-inch; charge of powder, 10½

The reloading tools made by the Ideal Manufacturing Company are of two classes: the small inexpensive hand tools, intended for individual riflemen, and the armory outfits, intended for turning out ammunition in large quantities. There is no difference in the quality of the work done with either. The principal armory tools are shown in Figure 24. A complete hand loading set for loading service ammunition, also bullets Nos. 308334 and 308280 or 208241, will cost about $20 with bullet moulds and lubricating and sizing machine, or about $9.50 if one does not intend to mould his own bullets. The armory outfit is much more expensive. The Ideal Bullet Metal costs from 11 to 15 cents per pound, according to the quantity ordered.

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grains, New Schuetzen powder; his score was 62 consecutive bull's-eyes. The second, third, fourth, and fifth prizes are awarded Patrick J. O'Hare, Private Company "L," 1st Regiment, N. J. N. G., Newark, N. J. The scores he made are 58, 54, 48, and 29; he used 10 grains Marksman powder: distance he shot, 100 yards; 4-inch bull's-eye. Both shot from prone position.

On Lincoln's Birthday, William H. French, of Newark, N. J., using bullet No. 308334, in a 100-shot match, 200 yards off-hand, made the following scores: 46, 46, 45, 46, 45, 43, 46, 44, 43, 47, total, 451. All the shooting was done with a Springfield .30-caliber rifle, Model 1903, chambered for 1906 ammunition.

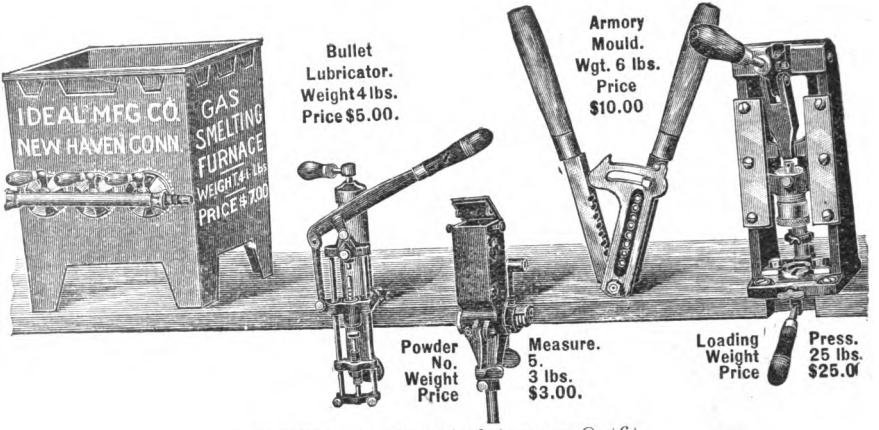


FIGURE 24—The Ideal Armory Outfit.

CHAPTER XVIII.

Company and Team Practice.

In taking a company or troop through the regular yearly preliminary and range practice, the endeavor should be made not only to obtain a high figure of merit for the organization, but also to thoroughly instill in each man the correct principles of good rifle-shooting. If men are allowed to use their own crude methods or to discover for themselves methods at variance with those heretofore given, a few of them may develop into fair shots, but it is safe to say none of them will ever become really excellent shots until they adopt the correct methods. An experienced officer can tell at a glance, when watching a company at practice, whether they have been well instructed in the correct form, or whether their marksmanship has been picked up haphazard. It goes without saying that most of the effort should be placed on the poorer shots, as a company composed of a great number of good shots is much more efficient on the firing-line than one containing a few excellent shots, and the method of calculating the figure of merit of an organization is so designed as to make

it more desirable to eliminate the second- and third-class men from the company than it is to develop expert riflemen. At the same time the presence of a number of excellent shots, well up in the theory of shooting, is highly desirable, not only that they may act as coaches, but for the example they set and the stimulus they give to the remainder of the men.

The following methods and order of procedure, used in the writer's company of regular infantry, have always been so perfectly successful that it has been deemed advisable to give them here:

When the period for preliminary drills has been designated by the regimental commander, the recruits and all men who have joined since the last regular target season are personally and individually instructed in the method of aiming correctly and in cleaning the rifle. The whole company are then put at work on the third tripod exercise, making triangles (see Paragraphs 14 to 22, *Small-Arms Firing Regulations*). Instead of the ordinary tripod with sand-bag, it has been found much better to use for holding the rifle a solid post 8x8 inches, firmly planted in the ground and projecting therefrom 4 feet 4 inches, having on its top a clamp or vise similar to the vise on a carpenters' work-bench. The

aim of the rifle is never disturbed in this, and the practice is greatly facilitated. In order to throw the sights off the mark, the elevation and windage of the rear sight are merely changed. As soon as a man succeeds in making fairly small triangles with both open and peep sight, he is excused from this work. The whole company will qualify in about four days, and no advantage is gained in keeping up this form of instruction any longer.

The men are next personally instructed in assuming the correct prone position, and in using the gun-sling. *No amount of pains and time is spared in getting every man absolutely perfect in this position. The men are told that this position and the use of the sling is compulsory.* This is followed by position and aiming drills in the prone position. The trigger - pull exercise is used almost exclusively, and usually "at will," the men being encouraged to pull twelve shots as carefully as possible, and then take a short rest. This trigger-pull exercise in the prone position is continued daily for the remainder of the preliminary period, being so arranged that each man gets about 10 minutes a day of it, the idea being that the men must be thoroughly at home and comfortable in the prone position. Referring to the regular season's course, it will be

seen that in record practice a man going through the marksman's and sharpshooter's course and expert test fires 143 shots prone, 30 sitting, and 30 standing, and moreover the prone position is used at the most difficult ranges; hence the great amount of attention given it.

About this time gallery practice is started, shooting in the prone position first, at 50 feet slow fire on the iron target.

The sitting position is next taken up. A little more latitude is allowed the men in assuming this position, it being merely stipulated that both elbows must be rested upon the knees, and that the heels must be placed in deep holes. During these position and aiming drills the pick-mattock intrenching tools are brought out to facilitate making elbow and heel holes in hard turf. Gallery practice in the sitting position follows.

The standing position is next taught. No prescribed position is insisted on, but the instructor endeavors to get each man to use a good steady position best suited to his own comformation and muscular development. Gallery practice in this position then follows.

When the instruction in the three positions is completed, rapid fire is next taken up. The instruction again starts with the prone position,

then the sitting and standing. The rapid-fire exercise of position and aiming drills is first used, then the men pass to timed fire gallery practice on the 50-foot target, and finally to rapid fire on an improvised rapid-fire gallery target.

Next skirmish fire is taken up, squads making dummy runs under a competent instructor, either on the regular range or at targets placed on the parade-ground. Great stress is laid on the proper manipulation of the piece and the correct setting of sights. Various winds are assumed and allowance made for them.

A certain class of men, the best shots in the company, will quickly qualify and graduate from this kind of instruction. These are put to work on a 50-yard range with the .22-caliber Winchester single-shot rifle.

Four or five men, the best shots practically and theoretically, are utilized during this work as assistant coaches, but the officers should give very close personal attention.

In position and aiming drills, targets are used which approximate as closely as possible in appearance and visual angle to what the men will see on the range. For instance, for position and aiming drill in the prone position the target consists of a long board, painted dirty green, to represent the butts on the regular range. Above it

appear the targets subtending the same visual angle as do the B targets at 500 yards. These targets are of brown (not white) paper, so as to make the simile complete, and they are placed so as to appear just as far apart as do the targets on the regular range. This trains the eyes and the men feel more at home when they come to aim at the regular targets on the range.

Every day these preliminary drills conclude with the company in single rank, and the position exercise is given. This exercise is not given as a drill, but as an exercise pure and simple, being continued until the men have to stop from sheer fatigue, the idea being to develop the muscles used in holding the rifle to the fullest extent. Needless to say, it would be a mistake to give this exercise at any time other than the conclusion of the drill.

Lectures are interspersed with this work every few days. First, the men are told the importance of calling their shots, and this is insisted upon all through the aiming drills and gallery practice. Then they are instructed as to the value of 25 yards change in elevation and 1 point in windage at each range, and the necessity of accurately and quickly getting their rifles so sighted that their shots strike the spot where they call their shots. In this connection they are taught to use

the "Table of Sight-Adjustments" given in Chapter VII., but they are not required to memorize anything, being told that they will find these tables at the firing-point when they reach the range. Next windage allowance is lectured on, and the men are taught to use the diagram of flag-lifts and windage tables. The instructor tries to make everything as simple as possible, giving the men nothing to memorize, but rather trying to instill in them the principles and reasons. If these lectures are made too complicated or scientific, they are apt to do more harm than good, the attitude of the men being, "Oh, what 's the use? That 's too deep for me; I can never learn that," etc. Only one idea should be instilled at a time, and that idea should be thoroughly carried out in the next three or four days' practical work. Occasionally the men's pride in developing themselves into good shots, efficient fighting men, should be appealed to, and also their desire for extra pay for increased grades of qualification.

The interest in this work should never be allowed to lag. The instruction should be so varied as not to become monotonous. Men should not be kept hanging around for a long time awaiting their turn, but should be allowed to go to the squad-room, to be called out in

plenty of time by their squad leader. It will be noticed that the men in the above course of instruction are steadily changed from one class of work to another. They progress from slow to timed fire, and just before their interest wanes in this they go to rapid fire on the queer little disappearing target, and their interest comes up again. Then comes skirmish. All this may be followed and interspersed by competitions, individual squad, section, and platoon, and gallery matches with other companies. Men making exceptionally high scores are granted certain privileges, prizes are given to the best squad each week, etc. This preliminary drill, extensive and complicated as it may seem, can be and usually is completed in 60 hours, usually distributed over a period of about a month. Three or four squads are always kept working at a time, each on a different thing, and the average daily work of a private does not exceed 1 hour. The men have an easy time, they are not tired out, and they look forward to this period of instruction.

The company then passes to the regular season's course on the range. Preliminary to this, requisition is made for ammunition and cleaning materials. The ammunition is placed in the store-room, opened, and the names of four men placed on each box. Men are instructed to use

ammunition from their own box; hence they have the same ammunition and their elevations and zeros are constant throughout all their shooting. Quart bottles of saturated solution of sal-soda and water are given to each corporal for the use of his squad in cleaning their rifles, but the men are advised that their chances for high qualification are better if they will purchase the regular metal fouling solution. Enough of this solution is purchased from the company fund to clean all the rifles in the company just before starting record practice. Tables of sight-adjustment and windage are made on strong paper, and placed on small boards, one for each firing-point, for the information of the coach and men shooting there. Candles are provided in each squad for blackening the sights. The hand-cart takes to the range each day the following articles:

Score-cards in box.
Firing Regulations.
Pencils.
Cleaning-rod.
Gunny-sack for empty shells.
Camp-stools for officers, first sergeant, and coaches.
Two pick-mattocks.
Board containing the Sight and Windage Tables.

Candle.

Four pairs field-glasses.

Canvas sheets (in wet weather only).

The men are divided into three sections for shooting. One section goes to the range at the hour of commencing shooting daily, and the others follow at intervals of about an hour and a quarter. Each man as he finishes shooting returns to the barracks immediately if no longer needed. This arrangement is made so that no man will have to lie around in the hot sun for three or four hours before shooting, a thing which will take the interest and life out of anyone. The daily order of shooting is as follows:

1. Extra and special duty men. They return to their work immediately after firing, carrying a slip showing the time they left the range, 15 minutes being added to the time to enable them to clean their rifles before going to work.

2. Officers and coaches. They must shoot before their eyes and nerves are tired from the instruction of the other men. They also gain a better idea of weather conditions, which helps them in their subsequent work.

3. The three sections in the order in which they arrive on the range.

4. The non-commissioned officer in charge of quarters, cooks, kitchen police, room orderlies,

etc., are allowed to shoot as soon as they arrive, and immediately return.

Often these methods cannot be carried out, owing perhaps to firing at two ranges in the same day, to special arrangements for skirmish runs. to instructions from higher authority, etc. But they, or some similar arrangements, are great helps.

The men are required, by company order, to have their sights blackened and adjusted for the estimated elevation and windage. Before getting into position, they show these to the coach, who verifies them. The coach instructs the men during all the instruction practice, every shot being pulled under his personal supervision. Coaching is very difficult and fatiguing work, and one coach would soon become worn out. Therefore a number of the best men in the company are selected early and trained as coaches, so that there may be at least three available for each firing-point.

A coach should be perfectly familiar with all the science and practice of rifle-shooting. It is desirable also that he be a good shot himself; otherwise he will fail to gain the confidence of many men. During the last few years, coaching has approached a very fine point, so that given men who can hold perfectly, sight correctly, and

pull the trigger without deranging the aim, a competent coach should be able to cause them to make the scores of experts even if they know little of the art of rifle-shooting. However, something more than science is demanded in a good coach. He must understand human nature, must know his men and be able to judge their characteristics. Coaching should take the form of careful advice and plainly understood directions. The coach should always avoid antagonizing his men. An officer who is feared by his men will never succeed as a coach. There are some men in every company who stand in so much awe of their officers that the officers can do very little with them. It is better to turn the coaching of such men over to an experienced private, and to rarely speak to the men while they are at the firing-point.

The coach should get right down on the ground alongside his man, taking care, however, not to shade his sights. All his directions should be in a low voice. He should avoid arbitrary directions and should be careful to give the reason for every bit of advice he gives, for his aim is not only to cause the man to make a good score, but also to give him valuable instruction. He should see that the man calls his shots every time, and calls them truthfully.

Coaching is particularly trying work on the man who attempts it, especially on the eyesight and nervous system. The coach should never attempt to watch every shot marked. Instead he should detail a man for a few scores to act as a spotter. The spotter tells the coach the exact location of each shot as it is marked. Fifty shots is enough work for one spotter, and he should then be relieved by another man, or there is danger of eye-strain. A man should not be required to act as spotter just before his firing. Also the coach should make himself as comfortable as possible at the firing-point. A "Gold Medal" folding chair is very comfortable and convenient, and it brings one down near the ground, as he should be to properly attend to his man. The poor shots and the men who have a tendency to flinch should always receive their instruction from the best coach available. Before the man leaves the firing-point, the coach should make careful memoranda of his sight-adjustments and weather conditions, particularly wind, each coach having a small memorandum-book for this purpose.

At 200 yards, both slow and rapid fire, the coach can do little but see that the men have their sights set correctly, that they assume good positions, and that they are careful about pulling

the trigger. At 300 yards a little more can be attempted, but it is in slow fire lying down that the coach gets in his best work. He must here see that the men call their shots and quickly get their sights so adjusted that their shots hit the point called. The sights must be moved accurately and just the right amount, the coach showing the man the "Table of Sight-Adjustments," and requiring him to tell him the correct change. The weather conditions must be watched closely, any change seen at once, and the man explained what change is necessary.

Men who fail to make their qualification as "Marksman" will almost invariably be found to have failed through low scores at skirmish. This must be ever kept in view through the whole of the marksman's course, and every effort made to get data for skirmish elevations and zeros. It has been found of the greatest advantage, after instruction practice slow fire has been completed, to take the company back to 200 and 300 yards and allow them to carefully target their rifles in the prone position. Before instruction skirmish runs are begun, all the elevation and windage data gathered by the coaches should be gone over and the elevations and zeros for each man worked out and given to him on a card, thus:

Skirmish Data.

Smith, W. J.

Range.	Elevation.	Zero.
600	640	¼ R
500	575	¼ R
400	500	0
350	450	0
300	400	0
200	325	0

This card is pinned to the man's left cuff in such a manner that whenever he assumes the firing position during the skirmish run it is in full view, telling him exactly how to set his sights. The coach who is taking the skirmish run down previously gives instructions as to the amount of windage to use at each range. Extra men provided with target diagrams and pencils follow the run behind the skirmishers, and, watching the target, carefully note on the diagram where the various shots struck, as indicated by the dust. After the run, the man's score and actual hits on the target are also noted on this diagram, and it is then pinned to the skirmish data card and the whole turned in to be used as additional data in computing elevations and zeros for the record skirmish runs.

In record practice, coaching, of course, is not allowed. The most experienced coach in the

company inspects each man's sight-adjustment before he goes to the firing-point, gives him the wind allowance and any other advice he thinks necessary. When the man gets to the firing-point, he finds there a score-card having on it the value of elevation and windage adjustments for that range, taken from the "Table of Sight-Adjustments." If he is in doubt at any time, he can refer to this, in making his sight-corrections. Behind each firing-point is another coach, who sees that each shot is marked and scored correctly, and looks out for safety precautions. On leaving the firing-point, the man gives to the coach at that firing-point his sight-adjustments, which are recorded and used as additional data for the record skirmish runs. The 600-yard slow-fire record also becomes very valuable as data for the elevations in collective fire. Every effort is made to work out absolutely correct elevations for the record skirmish runs, using all the elevation records at slow fire, both instruction and record, and also the records of the instruction skirmish runs.

The same principles are carried out through the sharpshooter's course. At long range the elevation records include a record of temperature. All men taking this course are required to use a score-book. Careful record is made of the wind and wind allowance at 500 yards, rapid

fire. Micrometers are available for such men as have sufficient education to use them. The long-range targets are marked with spotters. Field-glasses or telescopes are provided at each firing-point and the men are taught to watch the mirage. The whole practice is conducted, as it were, like a post-graduate course. By these methods it has been found that about three-fourths of the marksmen will qualify as sharpshooters.

The principal factors having to do with gaining a high figure of merit in collective fire are clear, well-trained, and loud commands, a careful adjustment of all sights at the correct elevations, and a close observation of the target with powerful field-glasses during the firing. At 600 yards, all the company should be required to set their sights for the first volley at their regular 600-yard elevation as determined in the marksman's course. At 800 yards, all who have fired the sharpshooter's course set their sights at their regular 800-yard elevation. The remainder of the company use an elevation just 200 yards above their regular 600-yard elevation, and likewise at 1000 yards. One of the lieutenants carefully observes the target through a powerful field-glass or telescope during the firing, and it depends upon his observance of the first volley at each range whether the elevations of the

sights, for the succeeding volleys or fire at will, shall be changed or not. The company is instructed to aim at the lower line of the prone figures, front sight just touching the figures. The right squad aim a little to the right of the center of the group, and the left squad a little to the left; the remainder of the company aim at the center. If possible, a day should be selected when the ground is dry, and when there is no mirage. Allowance should be made for wind by requiring each man to set his sights so many points right or left of his zero.

Prior to the expert rifleman's test, the sharpshooters who are to take the test are given as much extra practice as the ammunition allowance of the company will permit. Timed fire, long range, and a thorough checking of skirmish elevations should be given. On the day of the test the most experienced coach of the company should be present to give the men advice as to their elevations, windage, etc., just prior to firing at each range.

Team Practice.

As soon as the team is selected, the team captain and coach should organize them into pairs and arrange the order of their shooting. No men should be paired together who are not on friend-

ly terms. The best men at coaching and wind judgment should be paired with the poorer men. The first pair to shoot should be selected for their good judgment as to elevation and wind and their ability to find the target quickly. If they are the best shots, so much the better, as in a match the *morale* of the team depends greatly on getting a good start. The last pair should be old seasoned shots, not liable to get excited. They should also be able to shoot in bad lights, as often matches have been prolonged until almost dark. Once this order has been arranged, it should be adhered to and not changed except for the most important reasons.

When the practice starts, the principal duty of the coach is to see that the pairs coach one another in the best possible way. In slow fire, while one man is firing his partner should have his eye at the telescope, watching for any change in mirage or light, and trying, when the shot is fired, to catch its dust. He should caution his partner not to fire on the wrong target (many matches have been lost through one shot on the wrong target), and he must check him should there be any change in conditions. Pair coaching reaches its greatest development during a fish-tail wind, during which the coacher must be constantly watching the mirage and telling his

partner to aim at 6, 5, or 7 o'clock, according as the mirage drifts.

In rapid or timed fire, the partner not firing should be provided with a stop-watch, and should call in a low voice to his partner the expiration of each five seconds of time, as 5, 10, 15, etc.

In skirmish fire, should anyone notice a change in wind or other conditions, he should at once remark on it in a loud voice, so that those on either side of him can hear him.

As soon as possible, the elevation and zeros of all the rifles must be accurately learned, and their differences noted, so that one pair leaving the firing-point can give to the next pair their exact elevation and windage. Thus the good shooting will be continuous and no shots will be lost in finding correct sight-adjustments. To this end, when a pair come to the firing-point, they should enter in their score-books the elevation and windage of the pair going before them and should make their calculations from that, taking care that there has been no change in the conditions in the mean time. Keeping a record of this is also one of the duties of the coach.

At skirmish, other things being correct, a small error in judging the wind will ruin a team's score and their chance for winning.

An excellent way of teaching a team to correctly estimate the wind is to have in readiness every day on the range several rapid-fire F targets. The first thing each man should do when he comes to the range is to estimate the conditions carefully, set his sights, lie down, and fire one shot at this target at 600 yards. This shot, whether it hits the figure or not, will give him his data. Having the 600-yard data, the windage for the whole run can easily be figured.

This practice takes hardly any time, and by continuing it daily there will gradually develop in the team three or four men who estimate the wind so closely that they hit the figure nearly every time. When it comes to actual runs, the combined estimate of these men can be taken for the team, and I should say that nine times out of ten it will be found to be the correct windage. By the way, this is an excellent way of fouling the pieces, and thus getting some good out of a few cartridges otherwise wasted.

The guns of every member of the team should be zeroed together, so that when one man gets his correct elevation and windage, all the others can set their sights correctly from that data.

In 1907 the skirmish targets at the National Match were set a foot above the butt and against the sky; therefore no dust could be seen to show

where the shots were going. Some team captains had one man of the team drop a shot or two into the butt below the target at 600 yards, to get a correct line on the wind. The captain, lying behind this man with a powerful field-glass, caught the dust thrown up by the shot, and gave the wind to the rest of the team, shouting, for instance, "Hold a foot to the right." While perhaps good in theory, this scheme failed to work very well in practice, for the following reasons:

The man firing the trial shot found great difficulty, while aiming so low, in getting his sights aligned exactly under the center of the figure.

The responsibilty placed upon him caused him to become nervous, and he was liable to get a bad pull.

The team captain was sometimes unable to see the dust, particularly when the ground was wet.

The information came to the other members of the team too late to be acted on with accuracy.

It was extremely hard for the men on the ends of the line to hear the captain's warning.

For these reasons I believe the best plan is to take the combined estimate of the best wind "dopers" of the team. But it is necessary that these men have special training in this, as outlined above.

Skirmish is quick work. On a run, something has to be done every second of the time. It is difficult, indeed, to do any coaching without rattling the men.

Every member of the team should be provided with an extra rifle, to fall back upon in case anything happens to his regular piece. The elevations and zero of this rifle should be known accurately.

During practice the team captain should publish only the total score made by each pair at a range, and the total team score at skirmish. Each man knows, of course, what he made himself. This is merely a precaution to be taken in encouraging pair coaching, and in getting the team to work as a team, abolishing all ideas of individual competition. Nothing can hurt a team more than this latter condition. When each man is shooting to beat his neighbor, the *morale* and *esprit de corps* of the team are gone and the team is defeated before the match. Each man should shoot to make the highest score he possibly can, but, above all, to try to help his partner and the next pair to make higher scores still.

All these remarks pertain, of course, to preparing for competitions like the National Match, where coaching, except pair coaching, is prohibited. In matches where regular coaching is

allowed, the procedure does not differ much. The coach's place is at the firing-point, between the two men firing. No shot should be pulled unless all three men agree as to conditions and sight-adjustment.

CHAPTER XIX.

The Rifleman on the Battlefield.

Rifle-firing in battle, with all its excitement, ignorance of exact range, unsteadiness from exertion, noise, confusion, indistinctness and motion of the target, is a very different matter indeed from range-firing. At the same time, there is no doubt that target-shooting properly conducted is an excellent preparation for firing in action. The soldier who makes hits in battle is the one who has been so well trained on the range that without thought he never fails to take aim and to pull the trigger carefully without jerk. There are many conditions which confront the rifleman on the battlefield which never occur on the target range, and I have thought it well to consider some of these in this work.

Firing from a Rest.

On account of the excitement and exertion, it will often be difficult for the men to hold their

rifles with any degree of steadiness. The best way to overcome the trembling is to rest the rifle on some stationary object. In firing from an intrenchment, it will also usually become necessary to fire in this manner. A rifle shoots much higher when fired from a rest than when held in any one of the prescribed positions. This is on account of the solid rest interfering with the flip or vibration of the barrel. Moreover, a rifle does not shoot as accurately in this way (machine rest excepted) as it does when held in the hands of the man. A rifle will shoot the highest above its normal elevation when the barrel is rested on the object just back of the muzzle, and the difference becomes less as the point of rest approaches the trigger-guard. Solid rests like stone cause the rifle to shoot higher than soft rests like turf. The Krag rifle resting on a sand-bag 6 inches from the muzzle calls for a reduction of about 100 yards in the range. The same point of rest in the Model 1903 arm calls for about a 200-yard reduction. A safe rule is to deduct 150 yards from the range with the 1903 rifle if fired from a rest, and 75 yards with the Krag. Firing from a rest also alters the zero of the rifle, but this may, of course, be disregarded in action, as we are only desirous of exact elevation and a little horizontal dispersion is an advantage rather than otherwise.

The Bayonet.

The rifle will shoot much lower when the bayonet is fixed; also the zero is very much changed. These differences are quite variable for different guns, and will have to be determined in each case. As the bayonet is only fixed at close quarters, and as the character of fire at short ranges is almost always rapid where men are apt to shoot high, the causing of the rifle to shoot lower by fixing the bayonet works to our advantage. This, of course, applies to the knife bayonet. The fixing of the rod bayonet does not make much difference at short range.

The Battle Sight.

When the opposing lines get within mid range (600 yards) of each other, the sights will usually be ordered "laid down" and the battle sight required to be used. The battle sight is correct for 530 yards range; hence with this sight at shorter ranges the rifle will shoot high, and at longer ranges low. The following table shows the difference in aim which should be taken:

At	100	yards	aim	about	13	inches low.
"	200	"	"	"	23	" "
"	300	"	"	"	27	" "
"	400	"	"	"	19	" "
"	500	"	"	"	6	" "
"	600	"	"	"	24	" high.

The Ammunition.

The ammunition issued to the soldier in time of war will be from many different lots, much of it being manufactured by private factories on rush orders, and it will not be as reliable as that obtained from the Government arsenals in time of peace. This was the experience in 1898. Moreover, one never gets the same date of ammunition twice, and thus he can never tell what his exact elevation and zero will be. The only thing to do is to use the normal elevations, trust to luck, and try to see where the first bullet strikes by watching closely for the dust.

The Sights.

The sights must be guarded with great care against any blows which might throw them out of alignment. It will be impossible to keep them blackened, nor is this desirable when firing at khaki-clad targets in all sorts of cover and with all colors of background. Bright sights are, however, just as much of a disadvantage as on the target range. It will be an advantage to carry in one's pocket (not near rations, for it is poisonous) a lump of blue vitriol (sulphate of copper, or blue-stone, used in telegraph batteries). By moistening this and rubbing it on the

front sight, the sight will become lightly plated with copper and will then slow up very plainly on objects in the field without any glistening. The application of a little heat will turn the copper-plated sight back to a dead black.

Firing Up and Down Slopes.

When calculating elevations for an object which is either up- or down-hill, use only the base of the triangle, or the horizontal distance between the rifleman and the object, and not the actual distance on the ground. The tendency in firing down-hill is to overshoot, due to too great an estimation of the distance and the fact that in looking down one sees and aims at the top of the object, and therefore is very liable to fire over. It is a good rule, in firing down-hill, never to use any elevation for distances less than 500 yards. In firing up or down cliffs or at an enemy on a house-top, the angle being very great, place the rear sight as low as possible and hold low, or the rifle will overshoot.

Firing at Objects in Motion.

While the velocity of modern arms is extremely swift, yet some lead or allowance is necessary at all but the shortest ranges. The aim must be taken at the estimated number of feet in front

of the object that the object would travel during the time it takes the bullet to travel the distance. Let us take an example: An officer of the enemy is running from one bit of cover to another, direction of motion at right angles to the line of fire. Range 500 yards. At a run the officer will probably cover about 20 feet per second. The time of flight of the Model 1903 rifle at 500 yards is .709 second. Therefore the lead necessary is about 14 feet. Aim quite a little in front of the officer and on the same horizontal line. Try to get the gun off the instant he crosses a line 14 feet from your line of sight. If the man were moving obliquely at an angle of 45 degrees, only one-half the above lead would be necessary.

If the enemy is moving toward one, he should aim at the feet of the enemy, and if the enemy is retreating, he should aim at the shoulders.

A man in quick time covers 5 feet per second; in double time, 9 feet per second; running, 20 feet per second.

A horse at a walk covers 5 feet per second; at a trot, 15 feet per second; at a gallop, 25 feet per second; at top speed, 46 feet per second.

In this work one must be very careful not to overestimate the lead, as there is a tendency to do so, and it is very difficult to estimate feet when looking over the sights.

Importance of the Direction of the Sun.

If one can get the sun over his own back and shining in the eyes of the enemy, he has attained a great advantage which increases the nearer the sun approaches to the horizon. It will be almost impossible for him to be sighted upon with the sun near the horizon and back of him unless he outlines himself against the sky-line, while he can see and sight on the enemy with great clearness. If, on the other hand, the sun is in one's eyes and at the enemy's back, he should seek particularly good cover under the shade of trees, if possible. It is a great advantage under these circumstances to rig up sun-shades for the sights. These can be easily and quickly made by using the small pasteboard boxes which will be found in each pocket of the bandoleer. Pull out the ends and partitions and slip them as shades over the sights. Under these conditions, sights which do not blur are worth their weight in gold. It is the writer's opinion that the direction of the sun in planning attacks is not taken enough into consideration.

Judging the Wind.

Unlike firing on the range, there are no flags to give the force and direction of the wind. However mirage is often present, and we also

can judge the wind from the smoke-puffs, the waving of the grass and trees, the flight of insects, the feel of the wind on the face, and the way in which a few blades of grass thrown straight up in the air are blown away from the person. Horizontal errors caused by wind and other components do not figure much in battle, where errors of this kind give a dispersion of the shots that is very much to be desired. They do figure considerably, however, when one has a chance to fire on a leader of the enemy.

Finding the Range.

The methods of estimating distance given in *Small-Arms Firing Regulations,* together with trial shots, must of necessity constitute the only method for the individual rifleman to determine the range until such time as a satisfactory range-finder is invented. It is often better, in firing trial shots, to aim at some bare spot, where the dust kicked up by the bullet can be seen, than directly at the enemy. To see the dust at long range, a pair of field-glasses are needed. If a companion is not at hand to observe the shot, the glasses should be placed on an extemporized mount, just to the right of the right eye in the aiming position, and should be focused and set on the spot aimed at. It is then easy, immedi-

ately after firing the shot, to dart the head to the right so that the right eye looks through the glasses. At 1000 yards and over, this can be done quickly enough to catch the dust of the shot.

In finding the range for the company in action the following method is suggested: The company is presumed to be about to open the first fire in the attack, defense, or fire of position. The company being in line of skirmishers at a halt, the captain orders the expert riflemen to the right and left flanks and gives the command, "Find the Range." The expert riflemen, provided with field-glasses or telescope sights, settle down in pairs on either flank and endeavor by trial shots to find the range. The first lieutenant, taking command of the remainder of the company, endeavors to find the range by trial volleys. The second lieutenant and the two musicians proceed to determine the range with the Weldon range-finder. When each party is satisfied that they have determined the range, they notify the captain what it is. The captain stops the work when he is satisfied that he has the true range.

CHAPTER XX.

The Eyes.

There is no doubt that rifle-shooting is a terrific strain on the eyes. We use our eyes to aim the rifle, to see the target marked, to catch the dust where the bullet strikes, to judge the mirage, and to watch the flags and light; and from all this long-distance work we must jump quickly to the delicate adjustment of the sights and entries in the score-book. It well behooves even those with good strong eyes to take extra care of them during the target season. The eyes should never be used any more than is absolutely necessary, and then never for long-continued intervals. The judging of mirage with the telescope is a severe strain. For this work it is best to use the left eye, so as to save the right for the strain of aiming. Dark smoke-colored goggles are excellent to rest the eyes from the intense light often present on the range, but they should never be used in shooting. These are better than green or blue, because they are less opaque and there is less loss of color in objects seen through them.

After a trying day on the range, the eyes should be bathed in cold water, or, if any inflammation be present, in very hot water in which boracic acid has been dissolved.

Perfect vision is the greatest necessity to riflemen. If one's eyes are not normal, then they must be aided by glasses to attain perfect vision. Refractive errors in the eyes are of three kinds: far-sightedness, near-sightedness, and astigmatism. The fitting of glasses should never be trusted to anyone but a skilled oculist. This should be impressed on all riflemen with imperfect vision. Glasses selected promiscuously simply because they seem to give one perfect vision are very liable to ruin the eyes permanently in one target season by reason of the great strain from ill-fitting and wrong refraction; whereas in the ordinary work of every-day life trouble might not be noticed with them in five years. The glasses used should be very large, so that one in aiming will not see around their rims. Gold, silver, or aluminum frames should be used, as they will not rust. Ordinary lenses have only the full correction in the center, but the rifleman always aims through the extreme upper left-hand corner of his right-eye lens. For this reason, shooting spectacles should always be of the toric or meniscus type, in which the line of sight

in aiming passes through the lens perpendicular to its surface. These lenses have the full correction to their very edges, and if the glasses be well fitted, there is no strain, as there undoubtedly is in using the ordinary lenses. It is a great advantage to some men to have the glasses just a little smoke- or amber-tinted, as this will take the glare out of the eyes, prevent them getting tired, and even seems to aid the vision.

Most oculists, in prescribing glasses for far- and near-sightedness, will give those which have not quite the corrective powers necessary to give absolutely perfect vision, in order that the eyes may have a little leeway to work for their own good. While this is correct for glasses for ordinary wear, the shooting glasses should always have the full correction to give normal eyesight, as without this there will surely be strain.

It is an advantage, if one can do so, to shoot with both eyes open, as it causes less strain. Sometimes a man will be found whose eyes are in such condition that it is impossible to get perfect vision for him with the aid of any kind of glasses. The only hope for such a man is the telescope sight. Many experts have unusual vision. Some can see the spotting disks on the

1000-yard target with the naked eye alone. I have also in mind the case of a man who could see the bullets "splash" on the steel target at 600 yards. Such men, of course, have a great advantage over men with ordinary eyes.

APPENDIX.

THE U. S. MAGAZINE RIFLE, CALIBER .30, MODEL 1898.

(Krag-Jorgensen.)

The Model 1903 rifle has superseded this arm in the hands of the Regular Army and National Guard, but it still remains the arm of the Navy, the Marine Corps, the Philippine Constabulary, and of many military schools and colleges. It has therefore been thought best to give the following data regarding this rifle, by the aid of which all the foregoing information may be of use if one uses the Krag.

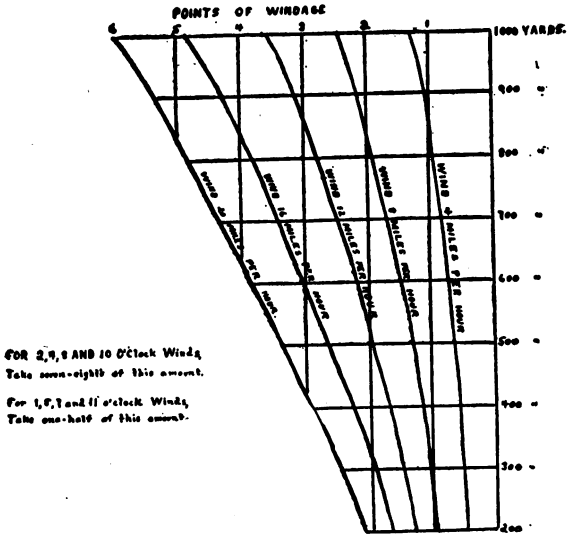
TABLE OF SIGHT-ADJUSTMENTS.

Range. Yards.	Value on the Target of a change of 25 yards in Elevation. Inches.	Value on the Target of a change of 1 point in Windage. Model 1901 Rear Sight. Inches.	Value on the Target of a change of 1 point in Windage. Model 1898, 1902 & 1903 Sights. Inches.
200	3	12	8
300	5	18	12
500	17	30	20
600	22	36	24
800	35	48	32
900	41	54	36
1000	50	60	40

Table of Rises in Elevation on the Micrometer.

For ammunition manufactured at the Frankford Arsenal subsequent to 1903, having a 220-grain, smooth bullet, and giving an instrumental velocity, measured at 53 feet from the muzzle, of about 1960 feet.

From	200	to	300	yards	rise	6′	with	micrometer.
"	300	"	350	"	"	3′	"	"
"	350	"	400	"	"	4′	"	"
"	400	"	500	"	"	$7\frac{1}{2}'''$	"	"
"	500	"	600	"	"	9′	"	"
"	600	"	800	"	"	21′	"	"
"	800	"	900	"	"	12′	"	"
"	900	"	1000	"	"	13′	"	"



WIND CHART FOR THE KRAG RIFLE.

3 and 9 o'clock winds. Model 1901 Sight.

Changes in thermometer, barometer, and hygrometer have the same effect and require the same micrometer changes on the Model 1898 rifle as on the Model 1903 rifle.

The private ammunition companies are now making ammunition loaded with a sharp-pointed bullet, which is more accurate than the old form of bullet. This ammunition requires lower elevation on the sights, and about half the allowance for wind that is required for the old bullet.

Micrometers for the Model 1898 rifle can be had from the J. Stevens Arms and Tool Company, Chicopee Falls, Mass., and from Thomas J. Conroy, 28 John Street, New York city.

The *Ideal Handbook* gives many excellent mid- and short-range loads for this rifle.

The best treatise on this rifle is "Modern Rifle-Shooting," by Dr. W. G. Hudson, procurable from Rifle Smokeless Division, E. I. Du Pont de Nemours Powder Co., Wilmington, Del.

U. S. Magazine Carbine, Cal. .30, Model 1899. (Krag-Jorgensen Carbine.)

Formerly the arm of the cavalry of the Regular Army and National Guard. Now used by the Philippine Constabulary and some military schools and colleges.

Table of Rises in Elevation with the Micrometer.

Frankford Arsenal ammunition, 220-grain bullet; velocity, 1880 feet.

From	200	to	300	yards	rise 4.9′	with micrometer.
"	300	"	350	"	" 2.7′	" "
"	350	"	400	"	" 2.9′	" "
"	400	"	500	"	" 6.6′	" "
"	500	"	600	"	" 7.7′	" "

One minute of elevation with the micrometer will move the shot 1.43 inches for every 100 yards of range, or practically 1½ inches.

One point of windage moves the bullet 8.66 inches on the target for every 100 yards of range.

The carbine uses the same ammunition as the rifle, but the velocity is 80 feet less, due to the shorter barrel.

Method of Cleaning Shells.

The following method of cleaning shells, devised by Dr. W. G. Hudson, I have used for a number of years with pefect results:

Two solutions are prepared and kept in telegraph battery jars, and used over and over again until exhausted. No. 1 Solution contains 2 quarts of water, 4 fluid ounces of sulphuric acid, and 4 ounces of potassium bichromate. No. 2 Solu-

tion consists of ½ pound of potassium cyanide in 2 quarts of water.

The shells are first thoroughly rinsed in hot water, then dipped in No. 1 for not more than 5 seconds, then rinsed thoroughly in water, preferably running water, then in No. 2 for a few seconds, and finally in water again. It may take two or three dips before the shells are absolutely clean. It is important that they be thoroughly rinsed in water between each application of the fluids. Finally they should be boiled in clean water for five minutes or more, then quickly shaken dry and placed in a warm place above a stove to dry. This warm place should not be hot enough to anneal them. The reason for boiling is to get the shells so hot that they will dry of their own heat. If they take more than about 20 minutes in drying, they are apt to corrode. This process leaves them cleaner inside and out than new shells. The process is greatly facilitated by using a home-made wire basket in which to place the shells, muzzle down while dipping. Both solutions are poisonous, and if mixed, will not only be spoiled, but will evolve poisonous fumes.

The National Rifle Association.

The National Rifle Association of America

was organized in 1871. The objects of the Association are: "To encourage marksmanship throughout the United States, particularly in the direction of qualifying as finished marksmen those individuals who may be called upon to serve in time of war; to encourage competition in marksmanship between teams and individuals; to encourage legislation for the establishment and maintenance of ranges; to secure the issue of military rifles and ammunition to those practicing thereat; and to create a public sentiment in respect to the necessity of rifle practice as a means of national defense."

The Association has done inestimable good in furthering rifle practice. It holds the largest and most important competitions in the country each year in conjunction with the National Matches. Every patriotic citizen, and especially every rifleman, should be a member. Life membership costs $25.00. For information, address Lieutenant A. S. Jones, Secretary, National Rifle Association, Hibbs Building, Washington, D. C.

The official organ of the National Rifle Association is the weekly paper, *Arms and the Man*, published at 1502 "H" Street, N. W., Washington, D. C. The subscription price is $3.00 a year. This paper is also the authority on rifle-shooting in the United States.